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ABSTRACT

Conference papers, recommendations, and discussion are compiled, focusing on the complex of problems associated with rapidly expanding urbanization and consequent rural dislocation. Topics exploring the problems included: air and water pollution; program planning and management; solid waste disposal; transportation; housing; crime control; health services; education; innovation; opportunities for State science action; system research and management for State and local systems; organizational fragmentation; mechanisms for resource allocation and program evaluation; new structures for Federal-State-local government cooperation; universities and public service; resources for State manpower and financing; industry and government; new communities; saving old towns; regional cooperation in the use of computers; citizen feedback systems; development of the shore and continental shelf of the northeast region; and technology transfer. Major emphasis was on defining these problems confronted by State and local governments in terms of the potential contribution that science and technology could make to their solutions. However, plenary session papers illustrated not only opportunities, but also social, technical, economic, and institutional obstacles in the path of technological innovation and application. (BL)

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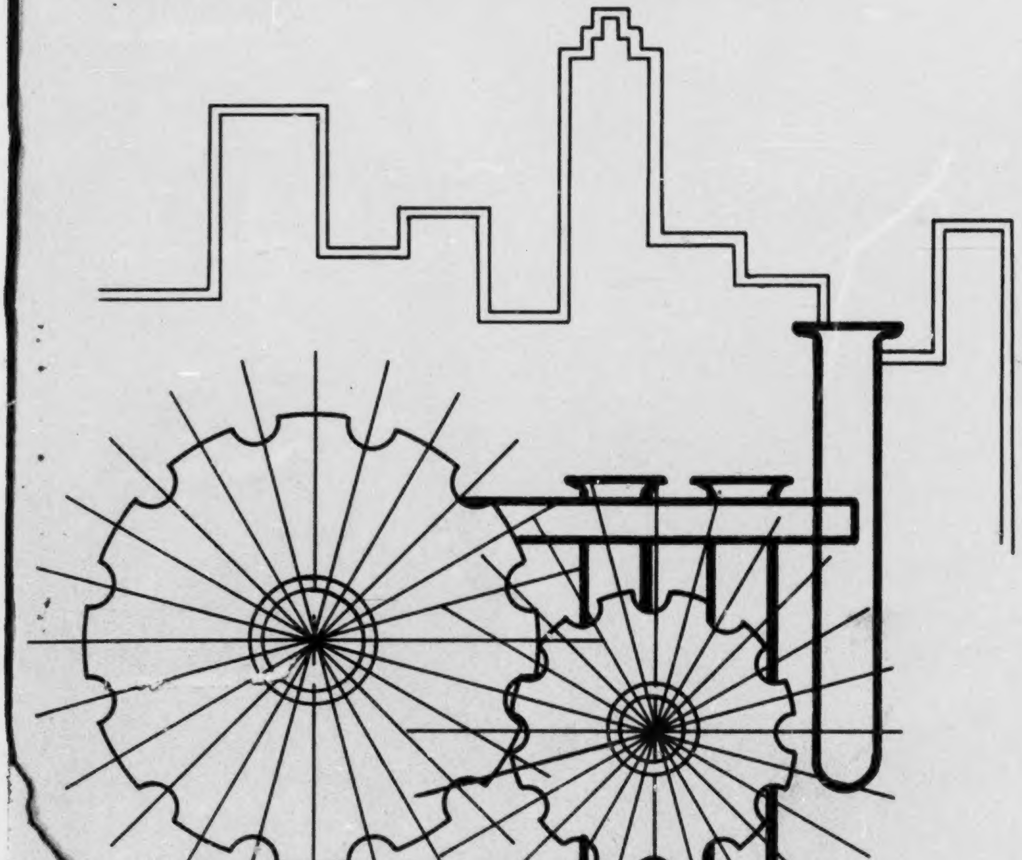
The Application of Science and Technology to Public Programs



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THE APPLICATION OF SCIENCE AND TECHNOLOGY TO PUBLIC PROGRAMS

Papers, Recommendations, and Discussion

of the

EASTERN REGIONAL CONFERENCE ON SCIENCE AND
TECHNOLOGY FOR PUBLIC PROGRAMS

Cambridge, Massachusetts
April 2-3, 1970

Edited by

IRWIN FELLER

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Center for the Study of Science Policy
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The Pennsylvania State University
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August 1971

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BACKGROUND

"The Eastern Regional Conference on the Application of Science and Technology for Public Programs" was the result of an intensive planning effort lasting more than a year in which numerous organizations and individuals participated. The New England Economic Research Foundation, upon a request by the National Science Foundation, assumed principal responsibility for designing, planning and managing the conference, which was to become part of a series of similar regional efforts in other parts of the United States.

This particular workshop conference focused on the complex of problems associated with rapidly expanding urbanization and consequent rural dislocation, characteristic of the northeastern region of the United States--on such problems as providing adequate housing and transportation facilities, controlling pollution, organizing and delivering health services, providing fire and police protection, education and training. The major emphasis was on defining these problems confronted by state and local governments in terms of the potential contribution that science and technology could make to their solutions. Case background papers were prepared that illustrated not only opportunities but also the social, technical, economic and institutional obstacles in the path of technological innovation and application. Out of this exploration of particular problems and issues emerged recommendations on the development of general state science policies, on specific technology utilization programs, and, in appropriate institutions, on the mechanisms of cooperation between federal, state and local agencies.

To achieve these conference goals the following objectives were adopted:

1. To identify potential applications of new technologies to social, environmental and economic problems at the state and local levels of government.
2. To identify some of the barriers to fuller utilization of available technological resources.
3. To consider new institutional arrangements that might facilitate increased science and technology applications and might overcome the technical and managerial obstacles to technological assessment and utilization.
4. To open up additional lines of communication among representatives of the science and technology community, state and local officials who are potential users and federal and state officials who are responsible for formulating and administering science and technology policy and programs.

The concept and structure of the conference was based on the following premises:

____ that the complex social, economic and governmental problems associated with public programs must be understood thoroughly before governmental science policies to assess the impact of innovative technological applications can be formulated and before application and control programs can be introduced.

____ that the gap between utilization of available technology and public programs is particularly wide at the state and local levels of government despite the critical need to improve the delivery of basic public services in such areas as housing, environmental control, health, safety, education and transportation.

In addition to the National Science Foundation and the New England Economic Research Foundation, the following institutions supported the conference by providing funds or other technical assistance: The U.S. Department of Housing and Urban Development; the nine northeastern states--Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont; the New England Regional Commission; the New England Governors' Conference; the NASA Electronics Laboratory; the Harvard-M.I.T. Joint Center for Urban Studies; and the Massachusetts Institute of Technology.

Dr. Robert C. Wood and Dr. Detlev W. Bronk not only presided as co-chairmen at the conference but also participated in the planning. To assure broad representation and participation from government, academic institutions and industry, not only at the conference but also in the conference planning process, three groups were established: Steering Committee, Advisory Board and Advisory Panel on Program.

The following professional staff members of the New England Economic Research Foundation assisted me in carrying out my overall responsibility for the conference: Caroline Bloomfield, Avery M. Colt, Jane Matheson.

I take this opportunity to express my deepest appreciation to all the individuals who gave so generously of their time and energy in order to help make this conference a success. The degree of cooperation of the diverse institutions who were engaged in the conference planning process is a demonstration of what will be required if science and technology is going to make a major impact on solving the crucial problems confronted by state and local governments.

Rudolph W. Hardy
Executive Director
The New England Economic
Research Foundation

NEW ENGLAND GOVERNORS' CONFERENCE
SUITE 4254, PRUDENTIAL CENTER
BOSTON, MASSACHUSETTS
02199

GOVERNOR KENNETH M. CURTIS, CHAIRMAN
MAINE
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INTRODUCTION

Those of us serving in public office often get the uncomfortable feeling in confronting complex problems that someone, somewhere must have the technology available to solve our specific needs if only we knew how to contact him. We all recognize the immense benefits to be gained from transferring scientific and technological discoveries into practical use.

With the help of the National Science Foundation, the Department of Housing and Urban Development and the Massachusetts Institute of Technology, we in New England have made a serious attempt to meet our needs. A committee of our states' science and technology experts spent long hours developing a conference format. Then, on April 2 & 3, 1970, world renowned scientific experts reviewed the latest developments in 24 different problem areas from Air and Water Pollution to Universities and Public Service. The papers compiled herein represent the results of that conference. They provide the raw material for bringing about change through science to solve complicated technical problems.

The challenges in government we face today are staggering. Only through study, communication and cooperation can we provide the many services demanded of us. Science and technology can be our tools if we develop and use them. We in New England hope that all who read this report will apply the information developed at our conference to achieve their objectives. If so, we will have achieved our goal.

Kenneth M. Curtis
Chairman, New England Governors' Conference
Governor of Maine

On the Application of Science and Technology to Public Programs,
Irwin Feller, Associate Professor of Economics and Program Director, Center for the Study of Science Policy (Institute for Research on Human Resources), The Pennsylvania State University

On the Application of Science and Technology to Public Programs—Irwin Feller, Associate Professor of Economics and Program Director, Center for the Study of Science Policy (Institute for Research on Human Resources), The Pennsylvania State University.*

I. A conference on the use of science and technology which places science and technology behind other solutions, and then catalogues the many factors mitigating against the use of science and technology by state and local governments is a chastening experience. Yet if any single theme ran through the Eastern Regional Conference on the Application of Science and Technology to Public Programs it was uncertainty about the extent to which science and technology should be or could be applied to domestic problems.

An uneasy coexistence persisted between this view of the overall tone of the conference and the continued confidence that each of the participants felt in the applicability of his discipline or solution. Paul Ylvisaker in the opening address to the conference had noted that it was the lot of " . . . academic scholars and activists always to talk about challenges as though they were problems." This opening measured tone of optimism and resiliency made unnecessary any additional leavening of the conference with statements on how science and technology could significantly contribute towards solutions to America's domestic problems. Moreover, it was implicitly understood that despite what must be regarded as severe strictures on the applicability of science and technology to public programs, efforts along these lines would continue.

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*I am indebted to my colleague, Marvin Rozen, for his perspective comments. Responsibility for the paper remains mine.

This disparity in the "sense" of the conference, however, makes it difficult to go from any of the specific recommendations of the workshop sessions to any general guide for public policy. An unclear mix of policies must be directed at coping with the dangers in, barriers to and limitations of the utilization of science and technology in public programs. The conference, by making this readily apparent, has made it possible, as described below, to obtain some perspective on what role there might be for science and technology and to identify those issues--some obvious, others less apparent--that determine whether such an application is feasible or beneficial.

The papers at the conference were directed primarily at the technical and administrative issues involved in the specific subject area of each workshop, e.g., municipal waste disposal systems, municipal use of computers. The underlying discussion in these workshops, though, grappled with the challenges and questions Paul Ylvisaker and Gustave Heningburg raised in their opening addresses: Are science and technology (or scientists and technicians) useful to public organizations? Who has decided that science and technology are needed in public programs? Are scientists or technologists willing to work in the value-laden environment of state and local government? Is there unanimity about the goals to be sought through the application of science and technology?

The conference in a sense proceeded on two levels. On one level, case studies describing successful (the use of closed-circuit television to make psychiatric care available to small communities in New Hampshire) and unsuccessful (the failure to get the New York City

Police Department to adopt a computerized system for the allocation of patrolmen) attempts to develop and transfer technological solutions to specific problems of state and local governments were discussed.

The second level, arising from the case studies, concerned the issues raised by the opening presentations, and the apprehension that unless these questions were answered there, indeed, would be little for science and technology to offer state and local governments, and a great danger that what was proffered would not be accepted. It was not, let it be clear, an obvious case of solutions looking for problems or of projects looking for sponsors. The tone of the discussions reflected an awareness of the complexities of America's social problems, and an understanding that science and technology were, at best, only part of any "solutions." Nevertheless, convening such a conference did involve an assumption (or presumption) that science and technology could contribute towards a realization of admittedly imprecise and often contradictory social objectives in areas such as environmental pollution, housing, education, transportation, health delivery systems, and crime control.

What emerged from this second level of the conference was an examination of many of the premises underlying oft-stated arguments on behalf of science for society and the need to redirect national scientific priorities away from space and defense towards domestic problems. The participants for the most part started from this premise, but were then confronted by the opening challenges to inquire into the value premises and assumptions of political hegemony underlying technocratic solutions. As noted by Paul Ylvisaker:

> Technology is, in a way, an extension of the medieval, of the bureaucratic kind of thinking which says, 'I want something impersonal as my lever. . . .' Now we move to the scientific-technological gibberish in which we say we are going to get a gadget, which is impersonal, which I can command fully, and has an impersonality which is going to move and engineer the system and resolve its problem. I've got news for you: the human being that we now deal with, that individual is willing to move, but he wants to move on his own, with reciprocal control, in effect, that probably makes us deal in infinite negotiation of consent.

II. The conference set forth a general statement of the role of science and technology in public affairs relative to other solutions. If one is willing, as here, to rearrange an obviously untidy series of discussions as a priority-ordering of these solutions, then an agenda for public action is generated.

A. The application of science and technology to public programs follows after agreement on social objectives.

This view, which was stated by a number of the workshops in their discussions and recommendations, reflects somewhat the professional orientations of most of the participants and highlights a limitation of the conference. In many ways the participants were calling for others to resolve the political and social disagreements which underly our nation's problems so that they, the scientists and technologists, could then get busy in designing and applying their solutions to narrowly defined technical areas.

B. Scientists and technologists should not set these social objectives, nor should they alone determine what elements enter into explicit or implicit calculations used to compute the benefits and costs of alternative technological solutions.

C. America's domestic problems are only partially of a technological origin, and to the extent that "unregulated" technology may be held to have generated them, e.g., air pollution, this was only because of a "permissive" political, social and economic system.

D. Solutions to America's domestic problems are to be sought, in order of relative importance, in:

1. Fundamental changes in political, economic and social relationships. Under this view, science and technology are not, as ordinarily regarded, dynamic elements in processes of social change. Rather they serve in a political sense to offer the possibilities of improvement without the need for any fundamental, non-technological, changes in the existing system, thereby indefinitely postponing such change. Politically, the appeal of "technological fixes" to problems is that they appear, in the economist's terminology, to offer the possibility of making someone (or everyone) better off without having to make anyone else worse off. The pursuit of such solutions is equivalent to the "growthmanship" approach to domestic problems of the early nineteen-sixties. Then it was believed that real increases in the size of gross national product could make possible increases both in private and public consumption and could provide the employment opportunities needed to reduce the poverty. Finally, this growth would generate the revenues needed by the federal government to achieve the "great society."

Under this approach, higher taxation to channel additional resources into the public sector to cope with our domestic problems would not be needed; questions of priorities within the public sector would not arise; large-scale programs of income maintenance (and redistribution) would not be necessary. But economic growth, even if it had continued at a full employment rate, could not have generated all the resources necessary for housing programs, transportation programs, etc., not to mention the fact that growth itself can aggravate these and other problems. At some point, fundamental decisions concerning which groups will benefit and to what extent from economic growth and which demands upon resources, public or private, will be fulfilled have had to and must be faced. Moreover, to the extent that these questions have been confronted in recent years, the decision has gone the way of channeling resources primarily into private consumption. The tax acts of 1964 and 1969 each provided for a general tax cut, which released relatively more resources to the private sector. At both times it would have been possible, as was argued in each case, to rely upon increased government expenditures to both stimulate economic expansion and to increase the flow of publicly provided goods and services.

The need for such decisions was clearly recognized at the conference. Reorganization of the nation's health delivery system was held to be more important in improving the general health status, particularly for low-income and minority groups, than were advances in biomedical technology. Changes not only in zoning laws, but also from which level of government they stemmed, were seen as providing more significant opportunities to furnish increased supplies of housing than were advances in modular construction. Science and technology can reduce somewhat the conflict inherent in many social situations by offering new possibilities or by reducing the cost of moving from one position to another. Still the cost of the search for such solutions and the time needed to develop and utilize them must be set against the near-term and possibly more significant improvements possible through political and economic changes which, however, require greater displacements of the present set of relationships between consumers and producers and between individuals and governments.

2. More money for existing public programs. Greater public expenditures, primarily funded by the federal government, can today ameliorate many of the nation's problems. These expenditures can be for existing programs and for existing hardware. It is likely, as many participants at the conference and others--including the Nixon administration--have argued, that a restructuring of public programs is needed to offset some counterproductive and grossly inefficient social welfare programs developed during and after the nineteen-thirties. But it still remains the case that in few areas of domestic concern are there production bottlenecks to expanded output, and that what stands in the way of a direct and immediate attack on what are termed "pressing" domestic problems is an unwillingness to spend more money.

3. Development and adoption of new technologies. New techniques, both hardware and software, make possible improved public services. The contribution of technology can take the form either of making possible qualitatively new services or of increasing the productivity of existing governmental programs.

III. Most of the conference's attention was focused on the last of the three general solutions. The general view was that state and local governments were singularly ill-suited to undertake, much less finance, significant research on solutions to their problems, and beyond that, with few well-publicized but isolated case studies to the contrary, they were unreceptive to solutions developed elsewhere.

As noted by Adam Yarmolinsky: "Generalized hostility to innovation is a natural and understandable characteristic of bureaucracies, and cooperative arrangements among complementary bureaucracies, federal, state and local, tend, unless otherwise directed, to reinforce this general institutional inertia." Resistance to changes involving the application of science and technology is part of this general institutional inertia.

Moreover, as brought out by many participants in the conference, but most pointedly in the presentations of Gustave Heningburg and Adam Yarmolinsky, there are additional barriers within state and local governments which impede the adoption of technologically based solutions.

A. These solutions cost money. Although some may be of the cost-reducing type, more probably will tend to permit an improved quality of service and thus increase the total government budget. Either type of solution will resemble an investment decision: an initial capital outlay generating a stream of benefits over time. The fiscal plight of the states and municipalities works against such undertakings.

B. There is little incentive in the political process, namely, a short-term tenure in office to induce long-term calculations. As put by Mr. Heningburg: " . . . for any mayor who is now in office a finance project which might benefit the next mayor because it may take three years or four years to develop the system is an unrealistic expectation from a pragmatic political standpoint." It is not only the gestation period here which may work against the adoption of technologically oriented solutions. Public officials will likely prefer visible, immediate and labor-intensive approaches to problems, e.g., more policemen, firemen, etc., than less visible, longer-term and more capital-intensive approaches, e.g., computerized allocation or high-technology communications systems.

There is little external incentive, in terms of appreciation by the electorate, or internal incentive, in terms of the workings of bureaucratic reward systems, for state and local officials to innovate. As noted at the conference, public officials make their mark not by being right, but by not being wrong. Given short-run time horizons, officials make their reputations by cutting costs (or by preventing them from rising too rapidly) than by improving services.

C. State governments often lack the qualified personnel to undertake research or to manage the rapid diffusion of technological solutions. The number of states and municipalities rules out, however, any generalization on this point. Indeed, one of the missing elements in the conference was any careful attempt to empirically assess the professional competencies of state and municipal personnel, or to discuss the issues involved in the brewing controversies over which level of governments are professionally equipped to formulate and to administer environmental control legislation.

It was noted that the low salary structure of state and local governments made it difficult for these levels of government to compete with other employers for scientific and technical manpower. Moreover, the civil service system used in government employment came under frequent attack as being too inflexible to permit employment of the needed personnel. (The attractions provided by such a system, e.g., security of employment, particularly in volatile labor markets, was public service given little weight.) There is a danger here that the validity of these arguments on pay scales and the limited innovative efforts to date of states and muncipalities may be taken as proof that state and local government personnel lack professional competencies, and that they must rely upon (or be subordinated to) the expertise of federal agencies. Differences in professional competences can obviously vary widely from state to state, city to city, and between functional departments at any level of government. One's view here is conditioned largely by which departments in which jurisdictions he has contacted. Work with the Department of Health and with agencies charged with air pollution control in Pennsylvania, Maryland and New York suggest that there is a generous sprinkling of professional competencies and individual excellence within state and local governments.

State and local governments, obviously, could benefit from such additional personnel, and improvements and reforms in pay scales and employment procedures may indeed be necessary. There is, moreover, need to reorganize the internal operations of these levels of government to give their professional personnel sufficient latitude to work to the fullest of their competencies. As a state official responsible for air pollution control has remarked concerning his agency's limited research activities: "To undertake research you have to be able to swing; you cannot swing (buy equipment, hire personnel) in state government." Still, the existence of qualified personnel within state and municipal government does suggest that future policies drafted at the national level to speed the flow of technological solutions to the problems of the states and the cities should not be based upon assumptions of federal technical preeminence.

IV. The application of science and technology to state and local problems involves two separate types of technological transfer. One involves the actual adoption by these levels of government of new technologies. This type requires either that state and local governments undertake research or that they possess the financial resources, responsives to innovation and managerial capabilities to absorb technical solutions developed elsewhere. This pattern of application would tend to be necessary where the service or problem in question presently falls almost exclusively within the domain of these levels of government. Police and fire protection would fall into this category, as would, clearly, new decision-making techniques, such as program-planning-budgeting.

The second type of application involves the use of new techniques in those activities which fall under the purview of state and local governments, but in which there are more organized supplier markets, in which jurisdiction is shared by the federal government, or in which some combination of organized supplier markets and shared political jurisdiction exists. Housing, transportation, environmental control and health service facilities would tend to fit into this category.

Although there is overlap and interdependence here, this separation of types of application is useful because it highlights the possibilities of employing external financing and external incentives and sanctions to promote a more rapid and extensive adoption of suitable technological solutions to the problems of state and local governments. One of the striking omissions in most publicly funded problems is that although large (if inadequate) sums have been spent on many domestic problems (e.g., housing, waste disposal systems), rarely had the legislation authorizing these expenditures required that the funds be used to purchase the most effective technology presently existing. Public works budgets and research budgets have generally been kept separate. One assumes, hopefully, that in the long-run the products of the research activities will become the standard items of the future, but this arrangement does nothing to insure that today's public expenditures purchase today's most effective technology. "Operation Breakthrough" of the U. S. Department of Housing and Urban Development offers some prospect of more closely tying together research and production activities, but the publicity attached to it is in large part due to its novelty.

Performance criteria can link public expenditures to best-practice technology. Clearly, the substance of any such criterion requires a resolution of disagreements over conflicting social objectives. Also, they are not a complete substitute for reforms internal to the operations of state and local governments. Still, such criteria can compel state and local governments to become adopters of new technology. Their use on a national scale also suggests a way to bypass the fragmentation of the public sector market which is held to make it unprofitable for private industry to undertake research and development directed at producing commodities for state and local governments and yet allows room, within prescribed limits, for different conditions and preferences.

A possibility along these lines is suggested in the proposed National Air Quality Standards Act of 1970 (S. 4358). As one of its changes to the Air Quality Act of 1967, the 1970 act would establish performance standards for new stationary sources. These performance standards "should be met through application of the latest available emission control technology or through other means of preventing or controlling air pollution." "Available control technology" is described as that "technology which is available or normally can be made available. This does not mean that the technology must be in actual routine use somewhere. It does mean that the technology must be available at a cost and at a time which the Secretary determines to be reasonable."

Little is known about the impact of such a requirement, assuming it is incorporated in the final act, or how widely across the concerns of state and local government such a requirement could effectively be employed. Its appeal admittedly lies in establishing by decree solutions not otherwise willingly accepted by other levels of government or by either households or firms. But these requirements also reinforce a pattern of federal assumption of responsibility for solutions to state and local problems. Political expressions of creative federalism aside, a dominant federal role does not always produce the solutions sought by area residents. It does not necessarily produce solutions appropriate to the level of government at which they will need to be implemented. What it does in the present context is perpetuate inertia and resistance to innovation within state and local governments.

The problem, in short, is that for all the reasons noted at the conference not only have state and local governments not been able or willing to respond to scientific and technological solutions, but, in addition, current federal policies do not, for the most part, assist them in this regard.

Major changes in tax sources, in manpower policies and in internal methods of operation are required within the state and local governments if these jurisdictions are to become more responsive to technological opportunities. None of these changes is in the offing. If anything, events since the conference suggest even greater obstacles to inventive and innovative actions by state and local governments. A recent report of the National Science Foundation, Research and Development in State Government Agencies, 1967 & 1968, shows an increase in state agency expenditures from $77 million in 1965 to $155 million in 1968, of which one-half was provided in each year by federal agencies. Although an impressive growth performance, the total expenditure is insignificant compared to R & D outlays of the federal government and of private industry. Moreover, the tight budgetary positions of many state and local governments, which have even led in some places to reductions in employment, do not leave much room for optimism concerning future state and municipal support for research and development out of their own revenues. Growth at the 1964-68 rate is highly unlikely, and the conjecture here is that, in real dollars, state R & D expenditures since 1968 have grown by very little. In addition, the softening employment market, both for the overall economy and within state and local governments, will most likely increase the resistance of public employee unions to attempts by state and local governments to provide improved services through the substitution of capital-intensive techniques (which, assumedly, embody scientific and technological knowledge) for existing labor-intensive practices.

Moreover, the ambitious efforts by New York City, for instance, to underwrite the type of research which is held as necessary to apply science and technology to municipal problems is under increasing attack from the New York City Council. The city's increased expenditures for consultants is being challenged, as is its relationship with the New York City RAND Institute. Not only have the seemingly unequivocal successes of the Institute--such as cited by Edward Blum in his description of RAND's role as a technology transfer agent in introducing the use of polywater to the New York City Fire Department--been derided by the City Council, but the argument has been made in this council that the studies undertaken by RAND could be performed at lower cost by the city's municipal universities.

The prospects then are unpromising that state and local governments on their own initiative and out of their own resources will be able, where appropriate, to develop or adopt scientific and technological solutions to their problems. Federal assistance is necessary. But the present manner in which this assistance is now provided--research on domestic problems in federal agencies and categorical grants-in-aid to state and muncipalities--is not effective. It does not effectively mesh together the superior taxing and regulatory powers of the federal government with the more detailed information and responsiveness to citizen preferences of state and local governments. What is needed are mechanisms in which state and local governments have a greater role in determining research priorities of federal agencies, possibly in the form of representation of research policy and project review committees of these agencies, or of federal-state research commissions, or of block grants to the states to finance research on problems of their own choosing. In addition, as noted above, greater use should be made at all levels of government of performance criteria which approach those which are technologically feasible.

These recommendations parallel several made during the conference. They are made with the same awareness of the limitations of organizational changesand of the role of science and technology in improving American society that permeated the conference. And like the conference, they are rooted in the belief that a realistic statement of the magnitude of problems and the limitations of solutions does not preclude action.

Gustav Heningburg, President, The Greater Newark Urban Coalition, Inc.

I come this morning with a few apologies to make before I share with you my feelings concerning the question about which you have assembled here. First of all, I regret that I was unable to be here yesterday to hear you discuss what *you* feel science and technology can do in public programs. On the other hand, that might be an advantage in that the opinions I have are based on my own experience, and perhaps if I had listened to the experts all day yesterday, I would have tempered my own comments, possibly making them less valid this morning. The second apology is that I am neither scientist nor technologist. My third limitation is that frankly I don't know what you can do, because I don't know the parameters of science and technology as they relate to public programming or the possibilities for public programming. However, the conference title itself seems to suggest that the scientists and technologists don't know either how . . . or whether . . . they can deal effectively with urban problems.

I come to you from a city which has been influenced recently by science and technology. I come from Newark, New Jersey, where electronic hearing devices and wire-tapping instruments, which are products of American science and technology, have made a major impact on public programming in the last few months. It has brought about the indictment, among others, of the mayor, several city councilmen, three corporation counsels, and three judges. This has resulted, as I'm sure you might understand, in an absolute loss of credibility in the integrity of municipal government. It is basically nonfunctional at this time. Newark is, however, a dynamic and exciting city because of its diverse racial and ethnic makeup. It could be called a typical American melting pot, except that nobody in the pot has melted up to this point.

I mention Newark only because I suspect the dynamics of Newark are not untypical. Our problems are those with which you will have to deal very realistically, if indeed there is a role for science and technology in the cities, counties and states.

May I first raise some questions with you, not for an answer at this point, but because they are important in the context of whether or not the products of science and technology will be accepted by public organizations . . . if, in fact, there is something relevant you can provide. The first question should be, "Who decided that we need technology and science in public service?" Was it the technologists and the scientists who decided that you have something to offer, or did the motivation come from state and local officials? This is a very critical question, because even if you can develop methods, processes, procedures, systems which can be useful in local and state government, you are wasting your time and talents if local and state officials have not decided they want your help. It may well be that as much talent needs to be put into creating the atmosphere in which science and technology will be accepted by public officials as you put into devising the techniques which can be useful to them.

I think it is a fact, although an unfortunate one, that most people who work in municipal and state government below the top elected and appointed levels are not noted for their creativity or their desire for experimentation and innovation; or their demand for change; or their willingness to accept what may appear to be a change which might put some folks out of their jobs.

The other question which needs to be raised is whether or not the scientist or technologist can act as the servants in public service. There is a fear on the part of some public officials that if they let the bright scientists into City Hall, or into the State House, the scientists are going to be running things very soon and not the elected political officials who have a direct constituency to respond to. I don't suggest that's the fact, incidentally, I simply suggest that that's the fear, and what you must deal with is not the fact but what people think is the fact. This, of course, is a direct contradiction of your normal discipline in which you deal with facts and realities, and not with images and impressions. Obviously, also, there is a tremendous lack of understanding on the part of public officials, and average citizens, about what science and technology can and cannot do. And I suspect there is also a lack of understanding on the other side of that coin, on your part, about what the problems are in the public sector and the difficulties you're going to face in seeking solutions.

I think, thirdly, that before you can really define a role, there has to be some unanimity about what the goals are. If, for example, you are going to deal with the problems of a city, the Newarks of the nation, you need to come up with a definition of what is the function of our cities. If you ask 1,000 people about the role of the city you probably will get 800 different answers. The suburbanites who work in the center cities and leave at 5 p.m. feel no serious responsibility whatsoever for central cities. They're very upset about them; they utilize and exploit them every day. It's the base which permits them to make money, to establish economic independence, and ultimately to move out of the city. Very often it serves as a cultural and entertainment center, where many things can be found that cannot be found in the suburbs. But there is no sense of responsibility or consensus on the part of the suburbanite as to what happens and what the future of our central cities is. On the other hand, the poor and the disadvantaged, who are being left to live and work in the center cities, don't know what the role of the city is either, because they have been very successfully excluded, historically, from any participation in the running of the city or establishing its function and seeing that they're carried out efficiently. So, in the absence of a clear goal of what our cities are supposed to be and do, it may be difficult to determine toward what ends science and technology can be applied.

Then, of course, there is the personnel problem. One of the characteristics of science and technology, I believe, is that of having the ability for long-range planning, for experimentation and possible failure. Local and state governments are uniquely designed to prevent long-range planning. The only people who stay there for any length of time are the middle-management and lower people--the civil servants who stay through successive political administrations.

They provide the continuity of government, but also are in the best position to create the most effective resistance to change and innovation.

In addition to a negative attitude about long-range planning in state and local government, there's no money for it. In Newark, the administration could never get away with setting $200,000 or a half-million dollars or a million dollars aside for long-range planning to develop processes and systems which would make government more efficient. There is no money for that purpose in the cities. The states may have a little bit more, but the pressures on state officials tend to make them less than anxious to spend it for experimentation and innovation, which may or may not work. And, of course, for any mayor who is now in office to finance a project which might benefit the next mayor because it may take three years or four years to develop the system is an unrealistic expectation from a pragmatic political standpoint.

There is one other factor which may be the most tragic of all. There is very, very little organized demand from the general public for efficiency in local and state government. The general public is not demanding efficiency of its governmental structures, and, in the absence of that demand, it obviously is not getting efficiency either.

Then there is the negative image which scientists and technologists have in the minds of many. There is a feeling, I believe, that scientists have devoted their talents to those who have been able to pay for their services, rather than to the needs of the community.

There's another critical problem which I think you have a much more direct ability to deal with. The "vested interest professionals" in our cities and states do not wish to have you muddling around in their business. The design of health delivery services in our urban centers, for example, could use some management systems and techniques to make it more efficient. Community residents are beginning to realize how bad the delivery of health service is, as opposed to what it ought to be. So a pressure is building now from the community, in the absence of a full understanding of what needs to be done technically, to produce that service. Your coming together here today is, in a sense, the result of that kind of pressure. But you are professionals and technicians, and, in the context of our discussion, this may be a liability--created by your peers in other disciplines. Let me explain: doctors and other medical professionals, working through medical institutions and professional societies, have done a great deal to inhibit the effective delivery of health services in our ghettos. Many of the tasks they jealously guard as their own could be performed by people with considerably less training.

In the construction industry, the unions have done a great deal to prevent technology and innovation in building homes. The efforts of your colleagues in developing new techniques and materials to improve the housing supply and lower costs have not been thwarted by the public, but by the "professionals"--the union men. You can go right down the line in the professions and the disciplines and find that the trained people are more effective at blocking innovation and change than "laymen." While it may be excusable for the general public, which does not have the training, very often, to understand the potential for science and technology, the roadblocks which are being presented by professionals are totally inexcusable, and cannot be justified on any basis at this point in our history. So as you enter this arena, you do not come with unblemished reputation to serve a breathlessly waiting clientele. You may have to spend as much time and energy proving your motivation as you spend displaying your capabilities.

The final problem is that many people in our urban centers, and particularly our minority citizens, have had many bad examples and experiences with the products of science and technology. At this moment, the census count is underway . . . a process which utilizes very sophisticated methods and hardware for receiving, tabulating, evaluating and reporting information. It's the national census count. For those of you who have received your form and read it, and are sensitive to such things, you'll notice that in the section which says "Color or Race," it lists several categories of people. The first category is White, the second says Black or Negro (which is some kind of response to social pressure, I guess) and then there are Japanese, Chinese, Korean, Filipino, American Indian, and other. The citizen fills in a dot beside the appropriate designation. Now, in our major cities in the East, we have growing concentrations of Puerto Rican citizens, and in the Southwest, entire cities composed of Spanish-speaking or Mexican-Americans. Spanish-descent citizens are the second largest minority in America today. Last week, the Puerto Rican leadership from the entire state of New Jersey met in my office, and when appraised of the fact that they would come out of the census designated only as "Others," they were deeply offended.

The development of that census form obviously was the result of a great deal of input by social scientists, statisticians and computer technologists. And it is deeply offending large numbers of our citizens. As we investigated it further, we found the problem was even worse. After bringing some pressure to bear, we learned that the Census Bureau had printed instruction sheets in Spanish, but had failed to develop a delivery system to get the Spanish-language instruction sheets into the hands of people who speak Spanish. The census forms are out in Newark, but the Spanish language instruction forms are not, because they don't have any system for getting them out. They don't know where to take them. Perhaps even worse is the sample form completed for Spanish-speaking citizens. All the names which were filled in on the sample were English surnames. They are the same names which came on your instruction sheet--August Rivers, Jane Rivers, Mary Rivers, the whole Rivers family is on there. That is not a very Spanish-sounding family. Moreover, when you go across the page to the column which says "Race or Color" on the sample form, the dot marked "White" is filled in. Now, the Spanish-speaking citizens who don't fully understand that form and who are going to follow the sample from the instruction sheet to the letter, are going to fill in "White" with the result that science and technology will have been used to produce a very distorted count of the racial and ethnic makeup of our cities, and we're going to be stuck with it for ten years.

Whenever you seriously raise the question of whether science and technology can help our cities and our state governments, you are basically talking about change. Unfortunately, or otherwise, the demand for change in America is going to have to come from the citizens. The movement for change which has come from the government historically has not been successful. If you use the example of the demand for integration, which came down "from the top," and which has been spectacularly unsuccessful even after 105 years of trying, you begin to see the kind of difficulties which will be faced if there is not a consensus for innovation and change in our governmental structures from the public.

Ironically, however, there has probably been no time in the history of this nation when the need for change and increased efficiency in government at all levels has been greater. There have been times in the past when we could manage change slowly and cautiously but with relatively little overt danger and disruption of the social order. We had leadership to which large segments of the population responded positively because the leadership was trusted and competent, and charismatic enough to motivate people to believe in that leadership.

But in the area of the relationships between the races in America today, which is a pragmatic definition of the "urban crisis," that basically is what you're talking about . . . whether or not people who are black and white and Spanish can live together any longer in that thing we define as a city, and make the city serve their needs efficiently. We are muddling along in a vacuum of leadership which has no parallel in our nation. I'm not talking about black leadership either. All too often we hear the question, when issues are raised, "Where is the black leadership?" On this issue, at least, America's black community may be suffering from too much leadership. We have more leaders per square foot dealing with this problem than we'll ever need. The vacuum is white leadership--political, educational, religious, labor, economic, and scientific.

You are all aware of the polarization afoot in the country growing primarily out of the demands by black citizens to define who they are and what they are and what their role in our society is.

All of a sudden there has come a recognition that the goal of integration which was established for black men at the time of the abolition of slavery was not established by black people at all, but was established for them by others. But it was accepted and almost universally unchallenged until about five years ago. It is imperative for those of you who are going to concern yourselves with applying science and technology to social change to understand fully the dimensions of what seems to be splitting the nation apart. The goal itself went unchallenged and unachieved for 105 years. It didn't work, but it wasn't challenged. Incidentally, I hope there's no one here who believes at this point that the goal of integration has been successful in America. If you examine the record of resources--human, financial, legal, moral, scientific--which have been put into achieving the goal of integration, you begin to wonder why it has not succeeded. Many people have died, millions and millions of dollars have been spent attempting to achieve the goal of integrating black Americans into the mainstream of this society. The Legal Defense Fund, for which I worked before coming to the Newark Urban Coalition, has spent over $2.5 million in court since 1954 simply trying to validate the Supreme Court decision on schools. And they're not fighting the Ku Klux Klan in court; they are fighting city governments, elected public officials, people who represent the will of the majority of the citizens in those communities to resist change. The reason that integration has not been successful as a goal in America is very simple--it has not succeeded simply because white America has not willed that integration will succeed.

Given that as the fact of the matter, it is not surprising that the black youngsters five years ago recognized that it has not succeeded and then began to examine the alternatives. And what is the alternative to integration for blacks in our society? The alternative is separation. There are no other alternatives in American life for its black citizens, other than integration on the one hand, or separation on the other. So it was a logical next step in the progression for the young people to conclude that if integration has not succeeded because white people don't want it to succeed, and the only other alternative is separation, then white America will be delighted when we demand separation. That seems like a fairly logical conclusion. Except that white America went straight up the wall when the kids jumped up and hollered, "We want black dormitories and black lunchrooms, and black clubs, and black this and black that." But if white America does not want us to integrate, and white America does not want us to separate, what, in God's name does white America want its black citizens to do?

The answer is unclear. And the white leadership which should be seeking to provide the answer to that question is silent and impotent. This is one of the major dynamics affecting our central cities today. It is a dynamic which may be susceptible at some levels to science and technology. But whether it is or not directly, the ramifications of that dynamic will be a major factor in whether or not you can get any acceptance for what your talents are in dealing with these kinds of problems.

There's another dimension to this which I think, also, you ought to be aware of. It is a very unscientific one, incidentally, and it has to do with an individual's role and his self-image. It is important for any man to know who he is, and what he is, and what his role in the society in which he lives is. And black citizens in America have never really been sure who they are or what they are, and they have never been able to organize around a common bond in our cities or across the nation because nobody has really wanted to identify what the common bond is. Organizing around a commonality is a very historic and constructive dynamic in our history. Groups from the very beginning of history in America have found a common bond--language, geographical origin, religion, and so on--and organized themselves around it. It has been a very constructive organizing force in our society. And black youngsters have decided--because we are great imitators--that maybe we need to do the same thing, because of the recognition that you have to build an internal group pride and strength before you can force your way into the mainstream of American society. So they looked around for what black people have in common, and found it was not education, because there are black Ph.D.'s and black second grade dropouts; it is not economics because there are a few black millionaires and a great many black poor people.

The common bond, ladies and gentlemen, is color. Color has been the foundation of segregation in our society ever since it started, and still is. It's also the only common bond that black citizens have one with the other across the nation. So it is not unusual that they decided that that is what we need to organize around. But the second step in the examination made it clear that color has been used in such a fashion as to create the impression that there is somehow a liability attached to being black, and all of us have contributed to this, consciously or otherwise. And, incidentally, whether or not it was conscious is irrelevant. At every level--in the animated cartoons--the villain is always in black, a black cape, a black hat, a black suit, and a black mustache, while the hero is in white, on a white horse, in a white suit, and with a white pearl-handled pistol. Look up the definitions of "white" in the dictionary when you go home, and once you go beyond the color part of it, it talks about hope, light. Look up the definition of "black," and once you go beyond the color, it talks about darkness and fear. This has been transmitted through literature for hundreds of years. Perhaps the classic example of what I'm talking about can be found when the stock market crashed one Monday morning many years ago. It was called Black Monday, because it was a disaster, not because black folks really had anything to do with the crash of the stock market. But it's significant that because it was a national tragedy, somehow it got assigned the moniker of Black Monday. Why not "White Monday"? Again, blackness being something that's wrong, a disaster, danger, trouble and so on.

Recognizing that common bond of color, and recognizing that it has been a real and imagined liability, the black youngsters instinctively understood the need to transfer a liability into an asset and do it very quickly. The result--the cry of "Black is Beautiful." It's as simple as that. To take the liability of blackness and make it an asset and, secondly, to make it an issue around which we could organize black citizens in this country, develop a power base, develop individual pride and a positive self-image, and then begin to force our way into the mainstream of this society.

There is very little understanding of this dynamic in our cities and our states, and virtually no understanding of this dynamic at the federal level, particularly under the present Administration. The insensitivity being exhibited at the federal level about racial and ethnic problems in America probably is the most critical problem we face in this country today, and that vacuum of leadership I talked about earlier becomes more and more glaring every day. If I would say to you in closing to very privately get out a pencil and a piece of paper and write down the names of the white leadership in America that you know of today, which has the economic support, the understanding, and the political power base to cause a serious reordering of the priorities of America so that we can stop spending our human and financial resources to kill people on the other side of the world and use them to make life livable in our cities, I suspect that you would come up with a large number of blank pieces of paper. The vacuum is there, the leadership is not. And I'm not sure what role you all have in creating the kind of atmosphere again where that kind of leadership can evolve to the surface. But until it does, and until there is a much better understanding of your capabilities and your potential, and, perhaps, most importantly of all, of your honesty in dealing with the real problems of our cities and our states as they relate to the dynamics of the ethnicity, the racial considerations, and all the rest--until those problems are solved and until that leadership is found, I am afraid that I am very pessimistic about the possibility of serious inroads of innovation, creativity, experimentation that comes out of your kind of discipline in solving our problems in the cities and the nation. On the other hand, and I must say this very emphatically, we desperately need, desperately need, every kind or process and system and equipment which can be produced by the creative talents of our society to deal with the growing problems of our cities, and that's the dilemma. There is no articulated demand for what you have to offer, but there is a great need for it, and I hope you have the solutions to both of those problems. Thank you very much.

Question: What courses of action can scientists and technologists take? You've indicated that we could come to the political leaders and interpret our capabilities for them so that they can either accept or reject, but yet you warned us earlier that if we do something for the political leaders we will be rejected just as the black man has rejected the help that the white man tried to give him in freeing him.

Answer: I didn't intend to convey that feeling. Let me take the end of the question first. I don't think the black man has rejected the help of the white man at all. As a matter of fact, I know he hasn't. I think what he has demanded is a redefinition of the roles. I think that what has happened is that the black community has said, "All right, from now on we will define what the goals are, and we will take all the help we can get from whoever will provide it to achieve those goals," but that's a very basic change, because historically the goals for the black man have been established by the white man. This was the significance of my point that the goal of integration was not established by black men for themselves. It was established, basically, by Northern, humanistically motivated missionaries who came into the South and were concerned about the freed men who had no education, no economic base, no political strength, and so on. I have been in many meetings where ghetto or inner-city residents have sat down to decide what it is they want, and the goals tend to come out in fairly general terms . . . for example, "We want better health service." But you can be sure that whoever is prepared, whoever has the talent to help them achieve the better health services will be welcome, regardless of color. Now, this redefinition of the roles has caused a great deal of agony, particularly in what we have tended to call the "white liberal community." They have been very helpful in the past in providing leadership, credibility and financial substance . . . but only for those goals which they have identified as being relevant to the black community. So there has not been a rejection of white help, but there has been a redefinition of the roles to be played by the parties in the act.

Now that's a long answer to the second part of your question, but I think it is important to understand that there is not a rejection but simply a redefinition of the roles, which says we will establish the goals for ourselves, but all the technical help we can get, we welcome. You know, we often have to deal with the question of corporations which want their people to be technicians and "community relations" vice-presidents at the same time. I'm not sure those two skills are compatible, since the training which is necessary to function with credibility in the inner city of Newark is not the same kind of training that's necessary to be a middle-management vice-president. So we have the problem of whether to take the community worker and try to make him a corporate vice-president, or vice versa. I think that we are stuck with having to take the vice-president and try to train him to be relevant in a ghetto community. We cannot train relevant ghetto leadership quickly to be scientists and technologists; it takes too long, and we don't have the resources to do it. But I think it is possible to condition scientists and technologists to be relevant in the ghetto, if you're willing to listen, and if you're willing to recognize the redefinition of the roles, which says that you are the servant and not the control agent in imposing or bringing in innovation into a center city.

Now, the other part of the response is that you have to be able to convince political leaders about the need for your "services and products." I think that's probably true. You're going to have to do a real selling job. You're going to have to make it clear to the political leaders that there is some benefit that they personally can get from you coming in with a new process that might be helpful. This is going to impose the demand of "instant success" on you and, secondly, instant cheap success, because they have no money . . . they really don't . . . so you cannot come in and say, "We want to institute a management system, Mr. Mayor, which is going to take five years to validate and will cost thousands of dollars to set up," because he's not going to be there that long. So the selling job on the political leadership is going to have to be very astute, very effective, before you can even get the go-ahead from them to come in. You're going to have to get resources from other sources to permit you to test in the cities because the cities have not got the money. Even if they had the will, they haven't got the money, and I don't really know what the sources are going to be. The federal government, which I believe has been the major funding source for scientific and technological innovation, for its own needs primarily, is moving away from the cities. Right now, when the cities are going down the drain at a high trot, the resources of the federal government are being channeled more into the states. This says something to inner-city residents who are just now beginning to organize themselves politically on a city-wide basis, where they can bring pressure on local, municipal political leadership, when the emphasis and the power represented by the federal government's money has now been shifted to the states. This shifts the power base one step further away from the center city. When you examine the relevance and record of state officials, and the sympathy of state officials, historically, to the plight of the cities, you recognize that we've got another very serious problem with which to deal.

I would urge you, if you can get support for programs of innovation in public service, that you direct your efforts to the cities first, to state-level governments second, because the crying need is there and the states now, under the present Nixon administration and the new federalism, will have much greater access to resources than the cities will. I plead with you, if you're going to start with this, use the cities as the experimenting base, and not the states first. Now, if you can do them both at the same time, fine. But, given the paucity of resources, I suspect you can't.

Paul N. Ylvisaker, Professor, Princeton University, and former Commissioner, New Jersey Department of Community Affairs

Robert Wood, in his usually gracious way, did not tell the truth entirely. He said that I was one of those capable of moving. Recently I did move--out of office. But if truth be told, I was moved: a casualty of a political transition in my state. I don't think a man in public life has really made it until he has been kicked out of office; at least I've achieved that distinction.

Bob also didn't mention my brief span as governor of the state. Perhaps I should explain how that happened. We were on what somebody called the ship of fools once, which was a governors' conference on a boat going into the Caribbean; it was an extraordinary conference. The year was 1968--when every governor became a candidate for the Presidency. The mood of the place was told when the wife of one of the dignitaries leaned back in her deck chair and said, "You know, somebody must have shot the albatross." We finally arrived in the Virgin Islands, where thousands of school children had been assembled to receive the governors and get their autographs. But the governors had little time or mood for that--not even Lester Maddox lingered to pass out his axe handles. In a very few minutes after we docked there were no governors but a lot of expectant school children. So a couple of us lesser officials took pens in hand and began providing autographs. I looked over at my companion, counsel to the governor of New Jersey, grinned and said "Hi, Governor!"--making him the first black governor in American history. He grinned back, reached for another paper being thrust at him, and asked, "How do you spell Rockefeller?"

I'm especially conscious of these problems of spelling, as you can imagine with a name like mine. The other day I made a claim to an audience that I was one of the few state officials in New Jersey who had left office without being mentioned on "the tapes." That's the Mafia tapes, as you know, and one guy got up in the back of the room and said, "Hey, you know why? They couldn't pronounce your name."

Bob also didn't mention another contact that we had here when we were graduate students at Harvard. It shows, I think, the kind of ingenuity of which the human race is capable, and ingenuity which is going to have to be drawn on at a pace which we have never known before, if we are to survive. It came during a seminar on urban affairs in 1945, as I recall. In those days, urban affairs were not so well thought of on Cambridge campuses; somewhere up in a corner we had a lovely professor side tracked by the university who taught a few graduate students, who still wanted to take subjects like this. One day he had a deadly topic, at that time, though Bob Wood would think differently today--some student was reporting on how they were financing the Mystic River Bridge in Boston. Everybody was going to sleep in the room, so the professor, deciding he would involve everybody, as professors are wont to do, pointed to a young Indian and said, "How do you finance bridges in India?" So that person took off on why the British should be kicked out of India. He went, as I recall, for 45 minutes before we had a chance to stop him. The professor then, desperately, turned to a Chinese general, who had found it convenient to leave China about that time, taking with him some of the wealth of that mainland. The professor asked, "General, how do you finance bridges in China?" And the general, pleased to be called on, but not comprehending the question at all, just smiled and flipped his cigarette and looked back genially. The question finally was repeated three times, and somebody translated it into Chinese for the general. And the general drew himself up and said, "We no build bridges, we swim across."

I think that kind of ingenuity, which may be counter-scientific and counter-technological, could well be the theme of the remarks which I am going to make, though I'd like to go a little bit deeper than that humor. I'd like to say a couple of introductory things. One is, I think we all, now, as members of the human race, realize that we have come to a sheer precipice--we feel the exultation of where we have climbed, and looking out over the abyss of our ignorance recognize how close we are to, perhaps, an end. I suppose that human beings before have felt that nature might shrug and the human species terminate its existence. But, certainly, we are faced right now with the very chasm of our ignorance that has been created for us by the mountain of our accomplishments. And that brings one, philosophically, into that mood, I think, of the Hebrews in telling the story of the Tower of Babel, which was built up until God said, "Sorry, no farther." I suppose that the moral of that story is that man does, instinctively, compulsively, build and elaborate, hopefully to improve and to rise, and he builds an extraordinary edifice, which becomes complex in geometric proportions as he proceeds. Interestingly enough, the end of that fable is that God demolished the structure and man was put back into the division of tongues. One could call that "confusion of tongues" chaos; yet it may be a return to simplicity, to manageable proportions of life. Yes, different languages; but each man, with his own language, could comprehend the limited sector he deals with.

Another relevant legend is the Greek tale of Sisyphus, who was compelled by the gods to keep pushing that rock up the hill until it achieved such a weight that it rolled back upon him and he had to start all over again. It's interesting that the Hebrews traced man's fateful destiny to the evil in him, or to his failings, while the Greeks attributed those fateful destinies to man's virtue, and I suppose we go puzzling on in our time wondering whether indeed it is our weaknesses that are killing us or it is our virtues. When we are uncertain whether it is our strengths or our weaknesses, our virtues or our vices, we're caught in a very confused moral position. We're plunged into a swimming sea of uncertainty--where, I suppose, man naturally must fall if he lives out his life and is part of his generation.

This intimation of uncertain destiny is an unsettling but exhilarating experience. I suppose like the man who falls off a precipice, it doesn't hurt until you land. But I do find it exhilarating for reasons I've already mentioned. However, it is our lot, as speakers, as academic scholars and activists, always to talk about challenges as though they were problems, when more than once I have given talks which I thought were basically optimistic, only to be met by people afterward who said, "You really are a Gloomy Gus." I don't intend this to be gloomy at all. I will talk about problems, or what I suppose are problems, but I'll wind up defining them more as challenges and opportunities. I am basically an optimist, not so much with the pretentions I brought to life as a Lutheran, as a Scandinavian or as a Harvard Ph.D. I'm not sure that if man survives it will be on my terms and preconceptions. Bob referred to 1967, when we lived in the dark depths of American despair--as he so aptly put it, "the domestic Pearl Harbor." Then I had a deep, deep sense of pessimism that we were shortly to see in the United States the final solution that Nazi Germany had come to, to liquidate its problem. I was wrong. I was wrong for a lot of reasons, all of which have given me the sense of continued buoyancy that there is a rugged logic of survival--man is extraordinarily stubborn. He'll survive but won't always or necessarily follow the logic or the course we and/or others may set for him. We could easily acquire ulcers and some emotional hang-ups if we became too fixed in our formulas for man's salvation.

The survival march of Americans these past few years--however erratic--leaves me with a general sense of optimism.

I'd like to trace for you now what I see some of our problems will be in the next ten years, in terms relevant to the topic of this conference. I think we are going to see more and more the divorcing of science and technology. Technology has been associated with hardware in this country, and in the Western tradition. Science will have to be extracted and abstracted from that perception of hardware. I'm not saying there aren't occasional "technological fixes" that can pull us out of moral and philosophical dilemmas. I can mention a few; some of them are very obvious. One we worked out with a Harvard management group. We were having trouble with our bureaucrats taking weeks of time to figure out the parameters and the mixes of subsidized housing. Now by telephone computer arrangements New Jersey's housing agencies can act almost instantaneously to make decisions about the feasibility of projects, and clear up some of the usual criticisms of bureaucracy. Another technological fix may have emerged the other day as I was talking to a group in New York, one of whom was versed in the techniques of the aerosol bomb. The question came up about all those slovenly dogs in New York, and what it's like if you take your morning walk along the East River, anyplace like that. One has to step high and gingerly, as you know. Now what do you do about the leavings of dogs in our metropolitan areas? Well, some of us politicians have taken the suicidal route of trying to get rid of dogs. If you want to take a tough fight in our time, try dealing with owners of dogs. I'd rather deal with the dogs. So, a technological fix is now being worked on, which is just a spray can, and as soon as the dog relieves himself, you spray it, and it either becomes hard, and then you pick it up, or it just disappears altogether.

I suspect that we're going to see a succession of these technological fixes. Jim Rouse, the developer of Columbia, Maryland--recognizing there is something basic about the instinct to have a house of $50,000 next to another of the same, not lesser value, cured the discriminatory consequence of that instinct by juxtaposing other equal-value housing in adjacent cul-de-sacs--so the kids then can overcome the prejudices of their parents, and attend the same schools, swim in the same swimming pools, play in each other's backyards. In that juxtaposition, you do have a technical resolution of a very difficult social problem.

I'm optimistic that we're going to have an almost dizzying succession of these technological fixes of social predicaments. But the kind of science, I think, that we are going to have to abstract from the hardware approach is the scientific process, the scientific mind, the capacity to be dispassionate, to see things large and whole. It has been interesting for me, as a social scientist (I think not just with a sense of I-told-you-so) that the medicine men of hard science, after 20 years of running fast and almost free, are now facing the same abyss of ignorance stretching out from their mountains of achievement. Hopefully, their--and all of our--sudden anxiety will readily mature into the constructive humility of an Einstein in his latter years, the gracious modesty of a Ben Franklin in his aged appearance at the Constitutional Convention. That recognition of ignorance is a chastening thing; it's a very good thing for us all.

But maturing does not mean abandonment of the hard sciences. The essence of their tradition still is essential in the softer areas we are forced to move in. It is a process of dispassion and reason, a mode of perception that all of us are going to have to acquire in what is now a decentralizing, a diffusing, and an individualizing society. We're going to have to provide those gyroscopic forces that once religion instilled and regulated as a group endeavor; those gyroscopes are going to have to be self-built in each of the individuals in our society. Those gyroscopes are not simply going to be received patterns of behavior, but they're going to be a widely-owned and individualized capacity to aggregate facts, to assemble these facts in the Linnaean tradition, to classify, and then be able to draw and act on generalized perceptions. The society that we have accumulated through uncontrolled population growth--by licking the Malthusian syndrome at least in the short run--this society cannot be managed anymore by the medieval conceptions that have applied to government policy, even the liberal New Deal syndromes, which have always assumed that bureaucracy, somehow following upon good legislation, is going to order this society. There is an anarchic character to our society, benign as well as malignant. I see in this anarchy the signs of individualization of our society--a process which creates and releases tremendous power. To use an analogy which I am sure is imperfect, urbanization is for human beings what the nuclear reactor is to the physical atom. When you have bombarded the atom, you have released and accelerated its particles, with a tremendous output of energy. Through that atom smasher of the city, the urbanization process, we have bombarded the family, the church, the labor union, the village, the small town, the feudalistic conditions, all those things which gave a person security, sometimes hemmed him in. In doing so, we have released the individual. He is now accelerated, being on the loose, and energized. Sadly, that energy is being dissipated because we have not learned how to control that power as well as we should. This release of the individual is chaotic; it is anarchic in many of its respects.

Still, in this sometimes formless, always spontaneous release of energy there is a logic--and no easy alternative of manipulated order or centralized social control. Certainly I've not known any one or group of human beings wise enough to comprehend and master and govern by the former conventions of bureaucracy; increasingly, we have to rely on the individual and his own inner directions, his own inner sense, his own capacities to be a "scientist" as well as any of us. Science can no longer be an elite preserve--but a quality and capacity common to all of us, a state of mind, the capacity to associate, to see larger trends.

Also, science will have to contend with values. (Now we are dealing with a garbage can full of obsolescent verbiage. I have one hell of a time with this topic because technology, science, society, urbanization are such unmanageable terms. We create our own realities by our conception of what those words really mean.) Values, what are they? All I know is that it's a part of the perverse nature of the human animal for another person to think differently than you, and by confronting you with his difference, to raise the philosophical question that there are two points of view, two realities, two life styles.

The values we're talking about at this conference are of a set that has been frozen into our society in the form of our constitutional bodies, known as states. We're talking too easily these days, I think, about extending science and technology into the dark continents of state and local government. It's very much like the missionary syndrome that sent my Christian forebearers to Africa, to Hawaii, to China, which says,"I've got the gospel, and I'm going to extend it to you." I can tell you that state governments are dark continents. I've worked in one of the darkest of continents, named New Jersey. The state governmental process is a dark continent. It is a shame and abomination on the American scene that state government, as a principal element in the American system, is in the abyssmal condition that it really is. There are exceptions, there are leaders, but they are precious few. Why? Because states have been out of the mainstream for so long, and being middle-level government have been able to avoid the urgencies that keep the national government and the local governments more lively. The mayor has to face an irate taxpayer every morning about the garbage collection. He can't go off into the 19th century and play farmer. The states have been able to do that. The federal government is caught with its urgencies, and even when it wants to retire, as it tried to do during the 1950's, sooner or later, we catch the tow of the federal government and bring it back down to our earth. But that middle level has been able to escape a lot of these urgencies and compulsions and in its inaction has allowed to persist on the American scene the values of an earlier society.

Now, if you're going to bring science and technology to the states it is by no means as superficially simple as to create another federal program that's going to give states money to do certain things, and then to examine every proposal, every piece of legislation that comes by and every bureaucrat and say,"Have you got your new science today?" That is an extraordinarily simple and superficial approach. It's the old bureaucratic system which is itself obsolescent; it's the old missionary syndrome, which is also obsolescent.

First of all, be prepared to look at the states as a frozen set of obsolete values, with tremendous inertial power running against you. On the other hand, I think that a good part of the technology that we want to introduce is really a false or spurious technology as applied to the value set that I have described. When they meet, these two spurious and/or obsolete sets, a complete kind of nothingness occurs. You'll not find governors very excited about bringing science and technology into state government, and I don't find scientists excited either.

If the conventional agenda of science and technology is irrelevant, where do we look? Part of the relevant action during the 1970's is going to be legitimately nihilistic. There's something in our kids today which is nihilistic, and not simply playing out the Turgenev confrontation of father and son, not simply because we've probably raised a generation of kids out of our affluence who don't have a role and who are looking for one. Not simply because they have been suffused with a McLuhan kind of culture which early makes them just about as cynical as an older person, if not as sophisticated. But these kids are beginning to see a few other things--that we do have institutions and values that are going to have to be destroyed. There is a "system," to use their term. Actually what they do not see is how complicated that system really is, the fact that it's not really under control, that nobody really has a complete mastery of it--and that's one of its problems. It's a system which, largely, is running on inertial guidance and is out of control. But they do see that this system, in some respects, must be destroyed.

I'll give you a very good example. We've got to "destroy" the American central city. I think there is no question but that the American central city is a complete anachronism, and more than that it's a deadly trap. It isn't just because we've seen some mayors weary of it and pull out, knowing that you can't "get there from here." We're beginning to see black mayors taking on that prize hoping that this is going to give the black man what he has been wishing for, a piece of the action. It does in one sense; psychologically, electing black mayors is a victory. It's a good thing; I applaud that. I'd rather have a black mayor of Newark than I would a white mayor, given the black majority in that city and the feelings that prevail. But, black mayors will be taking over a piece of dangerous obsolescence.

Now, we can destroy that central city in many ways. An unsophisticated way of destroying it is to go throw some bombs in Manhattan. The trouble with that, as the blacks found when they rioted, more people who throw bombs get killed by their own bombs than those they throw them at. There's another more sophisticated way of going at it, which has been represented by attempts to get metropolitan government to begin to break down the territorial lines which contain what we sense to be an anachronism. But that's anachronistic too, because it goes back to African genesis and the turf concept, and a measure of man which is inappropriate in our time, certainly to the complications of our time. It says you can draw a territorial line around a social problem; if you draw it larger you have a better chance of handling that problem. That is a fallacy to which I have been a party for about 10 to 15 years. Some places maybe you can do that; maybe a Denver can pull off a metropolitan government that makes some territorial and at the same time some functional sense. I don't think New York can, and New York, if anything, with Los Angeles, is a prototype of what we're going to come to in our increasingly fluid society. There are other ways of destroying the central city, and I've been watching now the ingenuity of man as evidenced in the Republican administration rather than in the Democratic administration. (You see, I don't get discouraged sometimes when the survival line doesn't follow my map. Being a liberal Democrat, I was kind of hoping my boys would do it. But it has taken Pat Moynihan and the Nixon administration to think through one way of destroying the central city.) That destruction takes place, in this example, though a process of income maintenance--which is to say to American citizens that they can no longer be captured by feudal estates known as central cities, that they are American citizens first, foremost, and always. No matter where born, no matter where they may move, they will be guaranteed a basic flow of income. What we have tried to do is to make the dependents in the American population the serfs of a feudal system known as a central city. The barons who lived outside of the central city, the suburbanites have recognized that it was to their advantage to let this obsolete feudal order continue.

But by income maintenance--and by nationalizing other costs as well, such as health--we will functionally begin to break out the citizenry, and particularly the dependent citizenry of the United States, from the economic trap of the central city. And, having released them from the servitude of living in the central city, you also release the mayor, who has had disproportionately to take on the costs of the dependent population of the United States, a dependency which is a national phenomenon and a national not a local responsibility.

Gradually I would expect to see a kind of functionalism erode those territorial lines that have drawn the central city.

There's another negative thing we have to do, which is to break up what suburbia represents. Suburbia is a process of selfish maximization, where, like an individual firm in the Adam Smith economy, an individual suburb tries to reduce its costs and to increase its benefits. It plays a maximizing game. If I were to be critical about anything in Jay Forrester's analysis, it would be that he has not only assumed the Darwinian version of the game that is going on. He really tells a city, "Don't expect to be part of a larger benign system that's going to help you. You take care of yourself." And he puts the central city on the same maximization basis as he puts the suburb.

I don't believe that that's going to answer either problem. The suburbs are going to have to be "destroyed." Our kids are right. There is something about the suburb which is obsolescent--its social isolationism, its calculus of self-interest at the expense of those it excludes. How is the suburb going to be "destroyed"? Not by the frontal assults of brave young kids who are going to hit the bastions.

It's going to take some other devices. One is the perception that, constitutionally, the suburb is off base. It uses governmental monies to perpetuate _de facto_ if not _de jure_ segregation. And it stymies both social and economic mobility. By allowing suburbs to discriminate and segregate, we have put legal obstructions in the way of mobility. But that mobility, if we are as an individualistic society going to survive, must be preserved. I can watch that mobility being preserved, not so much, as I say, by the frontal assault on the system, as by the growing recognition of industrialists who need labor out in those suburban areas, by the national government, gradually recognizing that the housing problem cannot be solved until you get access to the land which is held so defensively by the suburban establishment.

There _is_ a nihilistic, a destructive agenda that's legitimate in our present times, and I think that we, as scientists, are going to have to recognize that there is a negative role, a use for anti-matter as well as matter. We're going to have to give rationality to it, and avenue and access. We're going to have to find ways in which these larger principles can be worked out, without the violence of unsophisticated action.

Let me give you another perception which I think is extraordinarily important for the 1970's. Our society has perfected the mass production, distribution, and consumption of physical goods. Our economic order, manufacturing, has done remarkably well in accomplishing the Industrial Revolution. However, the services remain in the medieval mold essentially monopolistic in character. Services in our day are the growth sector of the economy with the potential to absorb the growing unemployment that we have. They are also the pathway to improving the quality of life. Now, how can we in a short time move to a service economy based on competition and a mass market--and consumer control? First, one must expect a very rugged decade of controversy and confrontation involving the guilds, professions, services and trades. They are presently enjoying self-regulation; they are exclusionary; they resist consumer representation. The result is a set of closed systems--the lawyers regulate the lawyers, the doctors regulate the doctors, the engineers regulate the engineers, the beauticians the beauticians, etc. They dominate the state licensing board--boards which few laymen know about, much less influence. Even our young protesters have overlooked these bodies and the closed systems they represent. I've asked young dissidents whether they have attended the meetings of these regulatory bodies at the state level. They don't and I don't, because they have never been publicized as to where and when they would meet.

Now, we're coming into a pluralistic order where the consumer is demanding a service and he's looking for competitive ways in which his needs can be satisfied. This is why the universities are in trouble, because there is a new populism abroad. The kids, the consumers of education, sometimes well, sometimes mistakenly, have sensed that they are in the hands of largely a medieval and monopolistic institution. One of the critical fights that's going to emerge is over Sesame Street, which has been shown, in a poll still to be announced, to be probably one of the most effective teaching devices yet introduced. Now, Sesame Street is the object of defensive attitudes and attack, because somehow the tube is emerging as a competitive form of education which the consumers are beginning to take to. Eighty-five to 90 percent of the ghetto residents of New York's Bedford-Stuyvesant and Washington, D.C., are tuned in regularly to that program, and the rates of acceleration of learning are already evident.

The same thing goes in the medical field. The medical establishment has not adapted itself to the rising market, the mass market; as a result, we're going to go through a decade at least of an engineered shortage of health services--which is going to be tragic. It will produce confrontation and occasional violence in a number of places as the consumer begins moving on the health establishment and says, "We want service tomorrow." I have, however, talked to some of those who have engaged in such protests and discovered how frustrated they are when they take on the problem of health services. Recognizing the imperfections of the service economy is one thing; getting better performance out of it is another. A long lead time is required simply to expand the supply of, say, health services; to reshape the patterns of delivery and the attitudes of practitioners involved, an agonizingly slow process of complex change--which is not to call for patience and long-suffering. Quite the contrary--the job is so formidable only the impatience and idealism of youth are likely to sustain the kind of effort that's required.

We're reminded again that the system--or systems--we live with are almost overwhelmingly complex--so complex that we're too often enervated by the realization of what it takes to change them. This is why we tackled the problem of the Meadowlands in New Jersey--simply and symbolically to assert the capacity of modern man to restore and once again live compatibly with his natural environment--to assert our capacity to fathom the intricacies of an extraordinarily complex system to factor out these complexities, and to dissolve by reason and the scientific method things which seem almost completely refractory and unmanageable. That piece of territory has every complication from the Mafia to the most elaborate questions of transportation and technology. It has the most complicated questions of intergovernmental relations. Step by step, utter chaos is being reduced to simple complexity; shortly I think you will see a plan for the Meadows which will assure us that we can master this extraordinarily complex system. Not perhaps to the point that ultimately you know where, philosophically, man is going, but so that man feels that the emptiness and apparent chaos of the abyss in front of him is traversable.

The Meadowlands is one of the major assurances my recent experience has given me. The medical school episode in Newark--which Bob Wood cited--is another. Whether to build that school in the heart of a crowded ghetto was the question savagely at issue. Early and tragic damage has been done by those who saw it as a simplistic matter of urban renewal. But it was not; it was a point of interplay alone, a myriad of complex systems and subsystems--the systems by which this nation migrates surplus labor off the land through mechanization of agriculture, the system by which we house them in the worst parts of the city, the system by which we try to get the service industries into the central city, and the system by which we try to negotiate consent. A Magna Carta was signed in Newark when we agreed rationally to work our way through the whirling clouds of controversy and complexity to see the logic of survival. It was done. The medical school is being constructed without any violence, and the black community is now in control of urban renewal land heretofore kept beyond their influence. You will find blacks once hellbent on violence now engaged in the exercise that all of us human beings have to endeavor, which is to contend not so much with known enemies as with a mysterious unknown, a complex system that yields to no simple formula or physical attack.

Let me conclude with what I would like to leave with you as the most important thing to say. And that is, there is something about technology, besides its gadgetry, that I would like to pull away from. Technology is, in a way, an extension of the bureaucratic kind of thinking which says, "I want something impersonal as my lever. I want to engineer something and have something in between me and the thing to be done, the person to be influenced, something which is impersonal." And so we used to structure bureaucracies which an autocrat could command. Kids don't go to work in bureaucracies any more, because they are seen as impersonal things. The public bureaucracies are failing because they are operated and perceived as impersonal mechanisms to accomplish some distant autocrat's social objective. Now we move to the scientific, technological gibberish in which we say we are going to get a gadget, which is impersonal, which I can command fully, and has an impersonality which is going to move and engineer the system and resolve its problem. I've got news for you, the human being that we now deal with, that individual, is willing to move, but he wants to move only when convinced, only when he has negotiated his consent. That means a long and arduous social process; but the means by which social action is going to be accomplished, the means by which social problems in our time are going to be resolved, will be through people and not impersonal gadgets. And the ones who understand this the best, and I do mean to make a demagogic appeal, are the kids, the energy potential of our society. We in New Jersey went to the young through internships and early assignments of responsibility. The fellow running the Meadowlands is 26 years old; he's saying in effect, "Here is a job to be done in a complex system where you cannot have the help of gadgetry or bureaucracy, but is a current essay in negotiated consent all the way." The young people understood it very well. They began to feel fulfilled. We produced an environment which, I suppose, is anti-bureaucratic, but which was one of the most productive that I've ever worked with. We got into their heads that they were people, that they were engaged in a cause which made intellectual sense. And when they had that internal gyroscope inside them it made sense, that they were in the main current of man's effort to survive. You could trust those kids to work without smothering them with supervision. They could steer their way confidently through the confusing swirl of life's every day because their gyroscopes and bearings were set, and they were bearings which they had helped set themselves.

And so I find in this rising generation of our youth the qualities we need to keep alive man's struggle to convert his predicaments into his achievements, his uncertainties into his inventions.

his crises into his creations. In releasing these qualities in the young, we refresh them in ourselves. And now is the time for all of us to be nineteen.

Honorable Edward Kennedy, Senator, Massachusetts

I am delighted to be here today to address the Eastern Regional Conference on Science and Technology for Public Programs. As chairman of the Senate Subcommittee on the National Science Foundation, I am, of course, continually concerned with the allocation of national resources for science and technology as well as with the social and economic return the nation receives on that investment. As a senator from Massachusetts, I am pleased that this regional conference is being held in Cambridge, which is the center for one of the country's most extensive and sophisticated and productive scientific and technical complexes. And I also find it personally gratifying to note that this conference has been stimulated and supported in part by the National Science Foundation Intergovernmental Science Program, which was the only NSF program last year for which Congress voted a larger authorization than was proposed by the President.

Science and service of society is the theme which underlies all of the stimulating discussions which have been held these past two days. All of you are painfully aware that in this century, as science's influence on society has grown more and more pervasive, the gap between scientific knowledge and society's ability to absorb that knowledge has vastly increased. The rapid pace of scientific progress has far outdistanced both the development of social thought and the social and economic structure required to channel technology for good and human purposes. And while scientists delved into the innermost regions of the atom and penetrated the outermost reaches of space, society was forced to rely on the mundane social and political and economic institutions which have gradually evolved through history. The increasing disparity between our scientific power and our social know-how has led to the unbridled expansion and explosion of technology, with adverse effects on the character of our environment and the quality of our lives. To point out these negative consequences of technology is in no way to disparage the extremely important contribution science has made to our civilization. Electric power and antibiotics and rapid communication and transportation are essential to our way of life. We cannot turn back the clock, nor should we wish to, since the positive benefits of science far outweigh the negative side effects. But the negative effects are on the increase and, particularly in the area of environmental quality, threaten to overwhelm us. We must begin to close the gap between what science is doing for society and what science can do.

One of the barriers to closing the gap is the continuing and extensive involvement of science with military affairs. For over a generation we have oriented our scientific talent and our resources toward military and space objectives, and away from civilian and social purposes. A major shift in national priorities is now a prerequisite for coping with the nation's social problems. Pious posturing about the environmental crisis, for example, will prove to no avail, without the accompanying allocation of substantial funds and talent to attack the problems of air and water pollution and solid waste disposal, and land use planning, and the like. The amounts required are far in excess of the timid programs which have been proposed by the Administration. We should take the financial and intellectual resources which have been invested in defense and defense-related industries and convert them to the most socially useful purposes.

This economic conversion will not occur automatically, and positive measures are required on the part of government in close cooperation with industry. In order to determine what role government should play, I conducted this morning the second of a series of hearings on economic conversion in Massachusetts. These hearings are an extension of two days of hearings held in Washington in December of 1969, by the Senate Committee on Labor and Public Welfare, of which I am a member. Several points have become clear from the hearings held to date. In converting defense R & D resources, we must go much further than merely providing jobs for scientists and engineers and technicians. We must ask the basic question, "Conversion to what?" Will we be satisfied with better color TV sets and better electric toothbrushes, or will we demand solid waste reprocessing and computerized patient monitoring in hospitals and area-wide fire and burglar alarm systems and effective air traffic control systems? Do we want detergents which don't require bleach or ones which won't pollute our rivers and our lakes? Do we want more spectacular, gaudy toys for children or computer-assisted instruction and audiovisual aids to help them in their schools? In short, do we want simply a larger gross national product or do we want a more fulfilling national life?

Conversion must be seen not just as an economic and technical challenge but as a human and social opportunity. Through the process of conversion individual scientists, engineers, and technicians will be able to redirect their talents to resolving our pressing social problems and restoring the integrity of our environment and enhancing the quality of our lives.

Towards these ends I have started to draft legislation which I intend to introduce in the near future to help prepare the way for conversion of defense research and development activities to socially-oriented civilian R & D. This legislation will require a gradual reallocation of federal R & D spending, 80 percent of which today goes to defense or AEC or NASA, from military to civilian uses. It will provide educational programs for scientists, technicians, management personnel, who must redirect their activities, and for the federal and state and local officials who will define the new market for socially-oriented research and development. In addition, the legislation will provide special financial and educational assistance to the small defense firms which are faced with the necessity of conversion.

But to close the gap between what science is and can be doing, we need to do more than shift national priorities from defense to civilian and social-oriented needs. There must be a corresponding shift of priorities within the civilian, scientific enterprise itself. The striking success of the physical sciences in the twentieth century has led to an over-emphasis on those areas at the expense of the biological and behavioral and social sciences. In recent years, steps have been taken to rectify this imbalance. For example, the President's Science Advisory Committee has received an infusion of talent from the biological and behavioral sciences. The National Science Foundation has been increasing its expenditures for the social sciences at a more rapid rate than that of the other sciences. Nevertheless, the process has barely begun. Out of a total of $190 million requested by NSF for science research project support in fiscal year 1971, only $17.3 million, or 9 percent, is requested for all of the social sciences. I recognize the warning of some of our scientific leaders that the social sciences do not have the foundation of concepts and techniques on which more rapid progress can be based. But I am convinced that we can do much better than we have to date, and that a larger share of our research funds can be constructively expended on the social sciences. I believe this is particularly true with regard to applied research, in areas such as crime and poverty and education and urban development. If we are not able to strengthen the social sciences and learn to apply them successfully to society's problems, we cannot bring technology under control and turn it to public programs and human purposes. But I believe we can succeed in this area if we demonstrate the necessary will and allocate the required resources.

In this connection, it is worth noting the 1968 revision in the National Science Foundation statute which Congressman Emilio Daddario introduced in the House and which I sponsored in the Senate.

This, the first fundamental revision in the NSF Act, extended the Foundation's mission to include support of applied research projects and the sponsorship of national applied research programs in areas of public importance and made explicit the Foundation's mandate for support for the social sciences. It is my hope that the Foundation will make full use of the 1968 revision and will continue to increase project support for applied research and social sciences.

A related need is for more extensive interdisciplinary efforts. Over the past century, most scientific research and education has been organized along strictly disciplinary lines. This organizational structure has enabled the scientific enterprise to flourish in the past, but in recent years its inadequacies for solving social problems have become increasingly evident. To come to grips with air pollution in a metropolitan region, for example, requires a broadly based interdisciplinary approach. Physical scientists are needed to delineate the causes and the extent of the pollution; biologists and physiologists to ascertain the impact of the pollution on the population; engineers to develop pollution control devices and alternative energy resources; economists and lawyers and political scientists to assure the adequate implementation of proposed alternatives. To encourage the development of such interdisciplinary approaches throughout the scientific and professional community, the National Science Foundation this year initiated a new program of interdisciplinary research on the problems of society. Upon the recommendation of my subcommittee, the Senate authorized $10 million for this program. Unfortunately, the final appropriation for this purpose was only $6 million. The

Administration has recommended an increase in this important program to $13 million in fiscal year 1971. I believe that even a larger increase is necessary.

On the national level, then, the steps we must take to close the gap between science's potential contribution and its actual contribution are clear. We must shift priorities from defense to civilian, socially-oriented R & D and increase the emphasis on the social sciences, on applied research, and on the interdisciplinary approaches to the resolution of social problems.

But these developments on the national level will only be meaningful if they are joined with equally effective action on the state and local level, in which government and industry and the academic community work together in the resolution of specific problems confronting the various regions, states, and communities. The NSF program of Intergovernmental Science Policy has played a key role in stimulating awareness of this challenge throughout the nation. All of the states have signified their intention to initiate programs along these lines and a number of conferences similar to this one have been held in other regions and in individual states. The NSF Intergovernmental Science Program has achieved these initial successes with an authorization of only $300,000 for the current fiscal year. The Administration requested $370,000 for fiscal year 1971. The House Committee on Science has increased this amount to a total of $500,000. I do not believe this amount is sufficient to carry forward this important program at the pace it deserves, particularly in light of the fact that the Office of State Technical

Services of the Commerce Department has been completely abandoned. This, then, is another area where increased expenditures by NSF seem necessary.

On several occasions this afternoon I have urged the NSF to increase its commitment to a particular program. The problem is to assure that the NSF has sufficient funds to meet an expanded commitment. The Administration authorization bill provided for a total of $500 million for the NSF. The House Committee on Science has recommended an increase of $27.6 million, and I'm happy to announce today that I will shortly introduce a bill calling for an increase of about $50 million over the Administration's authorization. This proposed increase will enable the Foundation to support worthwhile projects which have been dropped by the mission-oriented agencies and to support the programs that I discussed here. It is only through increases in governmental support for socially-oriented science that we can close the gap between scientific knowledge and our society's ability to absorb and apply that knowledge.

But I should like to stress that the future does not depend only on the actions of federal, state, and local government. It depends on the attitudes and actions of individual scientists and engineers themselves. In the past it is not unfair to say that science achieved much of its extraordinary progress through focus on the objective physical world and through a policy of neutral indifference towards most other matters. Today scientists must reject a stance of neutrality. Instead they must accept the responsibility for their actions, for the uses to which their work is put, for the priorities of the problems on which they work.

In closing, I should like to quote from the great philosopher and mathematician, Alfred North Whitehead. On the last page of his classic Science in the Modern World he said, "Modern science has imposed on humanity the necessity for wandering. Its progressive thought and its progressive technology make the transition through time from generation to generation a true migration into uncharted seas of adventure. The very benefit of wandering is that it is dangerous, and needs skill to avert evils. We must expect, therefore, that the future will disclose dangers. It is the business of the future to be dangerous and it is among the merits of science that it equips the future for its duties."

I should like to add that it is the individual responsibility of each scientist to see that science does indeed overcome the dangers it creates and equips society to face the future. Thank you.

Section A: Air and Water Pollution

"The Institute for the Development of Riverine and Estuarine Systems (IDRES)"--Melvin B. Zisfein, Associate Director, The Franklin Institute Research Laboratories, IDRES Founding Director and Chairman, Technical Board 1969-70

What is IDRES?

IDRES is a singular example of state-federal cooperation in assistance to concerned regional scientific and technological resources for the solution of regionally important environmental problems.

First, let us present the bare facts. Formed in June 1968 by a joint Pennsylvania Science and Engineering Foundation-National Science Foundation grant, IDRES is endeavoring to apply the talent and facilities of major educational, research, science, and engineering institutions to a coordinated series of programs directed toward the beneficial utilization of riverine and estuarine resources. These programs are expected to have an impact on commerce, industry, and transportation; waste management; recreation; biological resources, including food production; watershed resources; and construction and materials.

Currently, IDRES is composed of five member institutions:

The Franklin Institute
Lehigh University
The Academy of Natural Sciences
Temple University
The Marine Science Consortium of Pennsylvania

The first four of these institutions formed the original IDRES team, which began work in July 1968. In March 1969, after a petition to the IDRES Policy and Advisory Board, the Marine Science Consortium of Pennsylvania Colleges and Universities was admitted to the status of an affiliate of IDRES. This group, composed of nine colleges and universities,* is now being integrated into the IDRES team.

Two boards were created to guide IDRES in its operations: the Policy and Advisory Board, and the Technical Board.

The Policy and Advisory Board is primarily concerned with long-range guidance and, as the name implies, the policy of IDRES with respect to such matters as the structure of the organization, the admission of new members, the distribution of funds, etc. In addition, this board serves as one of the liaison points between IDRES and private industry and nearby regions through ex-officio representatives. Tactical guidance for IDRES comes from its Technical Board, which meets monthly to discuss the progress of current efforts, plans for future activities, and coordination of efforts on requests for IDRES involvement in new problems.

Next, let us consider the question: What is the need for IDRES and what programs should it follow?

Two years ago, this was a frequently asked question, sometimes belligerently. Today with the emergence of "environment," "pollution," and "ecology" as emotionally weighted words well known to the general population, the question is hardly asked at all. In fact, today, statements by prominent citizens containing strong indictments of the condition of our environment are abundant.

The time to start actively reversing the degradation of our water resources was at least ten to twenty years ago--not today.

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*Bloomsburg State College, Edinboro State College, Indiana University of Pa., Kutztown State College, Millersville State College, Philadelphia College, Shippensburg State College, Slippery Rock State College, and West Chester State College.

However, in the last few years, efforts have been accelerated somewhat to recoup lost time. Even today, however, in some circles, rhetoric and pious pronouncement are confused with the beneficial effect of the proper investment of real money. PSEF and NSF are to be congratulated for their seminal and continuing support of IDRES during a period when it took an "established great name" in the field to get any support at all.

The massive research and development resources and capability of the United States are now beginning to be directed at solving the problems of our rivers and estuaries. Government and industrial support is starting at many levels of research into the beneficial utilization of these important resources. Hopefully, the trend will continue and IDRES will grow constructively.

IDRES is oriented toward constructive action, both in problems of over-utilization of our water resources, such as chemical pollution, and in problems of under-utilization of these water resources, such as recreational development.

The primary immediate goal (and I emphasize the short-term aspect of this goal) of the IDRES consortium is to improve the utilization of nearby riverine-estuarine resources and their associated land drainage areas through the systems-oriented application of science and technology.

The longer-range goal for IDRES is that it become the recognized center for riverine and estuarine technology in the eastern United States, and, ultimately, that it develop a worldwide reputation as a center of excellence.

We have already made substantial progress on the way to these goals. Already IDRES is achieving some recognition as a center for riverine-estuarine technology, as witnessed by the unsolicited requests for proposals it has recently been receiving. Also, the IDRES programs currently being conducted are yielding productive results and laying the groundwork for advanced programs of constructive action in the region. In addition, numerous contacts have been made at federal, state, and local levels and in the private sector of the economy relative to obtaining the collateral funding required for IDRES to achieve a degree of financial independence.

IDRES is a prime example of the science and technology forces of a region reacting to "grass-roots" stimulation to create a center of excellence to solve problems considered important and urgent in the region. It has established itself as a dynamic, self-developing and improving association of scientists and technologists of diverse relevant disciplines, working in close frequent communication and in close association with sociologists and economists when necessary to apply a broad, systems-oriented approach to achieving beneficial and enlightened use of our water resources. Perhaps the most remarkable fact is that IDRES is now the active and productive nucleus of a true center of technological excellence, when two years ago it did not exist.

In meeting its primary goal, IDRES has adopted a systems-oriented approach to problem solution. Such an approach offers numerous advantages over an uncoordinated series of individual efforts by individual institutions.

IDRES Programs

Technologically speaking, the main IDRES problem areas are:

1. Pollution
    - a. Chemical
    - b. Thermal
    - c. Sedimentation
    - d. Biological
2. Recreation
3. Navigation
4. Esthetics and Conservation
5. Systems Study and Development
6. Riverine-Estuarine Information Accumulation, Storage, and Dissemination

IDRES' first-year programs are summarized in Table I.

Thermal Pollution

IDRES' first-year efforts in thermal pollution consist of three separate projects. In each of these a limited scope scientific "bite" is being taken to provide useful information. The first two deal with the effects of discharge of heated effluents on the ecology of the Delaware; the third with engineering considerations which could conceivably mitigate the effects of thermal pollution. The ecological studies are being conducted jointly by the Academy of Natural Sciences and Lehigh University.

In addition to these ecological studies of the effects of thermal pollution, IDRES is also investigating certain factors in the engineering aspects of cooling towers. The most cost/effective cooling tower design currently available is the so-called natural-draft tower; this type of tower has a large stack to create a chimney effect which draws cool air into contact with the hotter cooling water. Although this

Table I

Summary of First-Year IDRES Programs

Investigative Area of Subarea	Study Title	IDRES Institution(s)	Principal Investigator
Thermal Pollution	Ecological Study, Delaware Estuary	Academy of Natural Sciences	R. Patrick
	Ecological Study, Delaware River	Lehigh University	S. Herman
	Engineering Study, Delaware River	Lehigh University	L. Wenzel
Sedimentation	Sedimentation in Delaware River and Estuary	Lehigh University	J. D. Ryan
Industrial Wastelines	Industrial Liquid Wastelines	Franklin Institute Research Laboratories	R. Erb
Recreation	Systems Engineering Study at Eastern Pennsylvania	Franklin Institute Research Laboratories	W. R. Reeves
Systems Study and Development - The Delaware - Present and Future	Development of a Predictive Model of Delaware River and Estuary	All	J. S. Huston S. Kleinberg
Information Accumulation and Storage	Establishment of IDRES Information Center	FIRL, Science Information Services	P. Devlin

method has considerably higher construction and installation costs than forced-draft towers, its low operating and maintenance costs outweigh this disadvantage and make it superior for most installations. As part of the IDRES research program in this area, a report has been prepared describing the best design procedures currently available for both natural and forced-draft cooling towers.

Sedimentation

The next IDRES program is a study of sedimentation. Sedimentation in the Delaware River and estuary has long been a major problem. Expensive periodic cleanups are necessary to permit navigation. The goal of this study is to ultimately formulate a strategy for minimizing the adverse effects of sedimentation through understanding of the transport and deposition mechanisms, and identification of the major sources of the sediment load.

Toward this end, simultaneous study of available literature on historical sediment transport in the Delaware and a core-sampling program of sediment buildup in specific areas of the Delaware have been begun. Both efforts have been rewarding in the determination of some sources of sediment loads in the Delaware.

Industrial Wasteline

The disposal of various wastes is a significant pollution problem in the highly industrialized Delaware riverine-estuarine complex. IDRES is currently evaluating the feasibility of a pipeline system to carry a number of wastes from the Delaware Valley industrial complex to a deep ocean outfall (beyond the Continental Shelf) where the wastes would be released, diluted, carried away from shore, and ultimately either become ocean bottom sediment (typical for nondegradeable wastes and dredge spoil) or be returned to the ecocycle via gradual chemical and biological action.

There are several major problems under study in this program. Work is proceeding simultaneously on obtaining practical solutions to them. I would like to mention a few of these problems to you and outline our efforts to find answers.

Problem 1 is assessing the real need for the proposed wasteline. Previous contacts with various public data sources yielded insufficient data to construct all but the simplest of models of the types and volumes of industrial wastes anticipated. Current work includes categorization and quantification of various discharged wastes and analysis of appropriate concentration methods. We feel that we have arrived at a sophisticated position in knowing what wastes would realistically be "customers" for a wasteline. These include dredge spoils and the residual sludges of industrial recycling treatments and municipal sewage treatments.

Problem 2 is behavior of released material at an outfall. Investigations are currently proceeding into the nature of currents in the area of the outfall, the use of diffuser-type outlets, the general baseline ecology of the area, the effect of waste discharge on the ecology, and the mixing behaviors of materials of differing densities in deep-ocean discharge. Of paramount importance is the short, intermediate, and long-range behavior of wastes discharged over the continental slope. How should they be collected and mixed? How should they be discharged? Where should they be discharged? How will they become diluted and dispersed? How will the nondegradeable sludge components or dredge spoils behave? How will the degradeable components re-enter the ecocycle? How can disruptive effects be avoided? How should the line be monitored? A number of ocean research trips have already been made, including one submarine trip, and many more are projected. The initial engineering team has already acquired a marine biologist and much more biological-ecological capability will be added.

Problem 3 has been the evaluation of pipeline construction systems. The construction of the deep-ocean section of pipeline was thought to be the greatest potential economic barrier to the successful completion of a wasteline system. Current ocean pipeline techniques use divers extensively to join sections of the line. Several methods of obviating this difficulty have been explored. One is the use of recently developed high-density polyethylene pipes 40 inches or more in outside diameter. A composite system has been developed with a polyethylene core, over which a continuous glass filament (such as fiberglas) is wound and impregnated with epoxy or polyester resin. This system, which has the desired structural rigidity without excessive wall thickness, also can be extruded and laid continuously from a moving ship. Because the need for divers also would be obviated with this system, it promises to be considerably less expensive than conventionally installed systems using metal pipes; this technique could revolutionalize the art of deep-ocean pipeline construction.

Recreation

The next IDRES program in Table I is the recreation study. The purpose of this study has been to evaluate the water-oriented recreation potential of eastern Pennsylvania, and to prepare a résumé of investment opportunities which would both provide recreational facilities in Pennsylvania that meet the desires of the population, and focus private investment into developing the recreation potential of eastern Pennsylvania.

Systems Study

The next first-year program in IDRES is the development of an input-output mathematical model designed to predict the short- and long-term consequences of any event on the physical, biological, and economic state of the Delaware riverine-estuarine complex. The first year's efforts of this program centered around the formulation of the model concepts, selecting meaningful inputs and outputs, and specifying the necessary transfer relationships to put them together.

Recently, by action of the IDRES Technical Board, a new and active committee has been created to combine the efforts of all institutions and create an advanced mathematical modeling effort to describe a specific and currently important problem. This group is now preparing a proposal to develop the mathematical modeling of eutrophication in lakes and impoundments.

Information

The final item on the list of first-year IDRES program, the IDRES Information Center, was established to serve as the information bridge between the research personnel of IDRES and the many sources of information pertaining to the varied facets of riverine-estuarine research, development, and utilization, with special emphasis on those subject areas which fall within the scope of IDRES research projects.

Major emphasis has been placed on identifying and contacting sources of pertinent information; acquiring and organizing information from these sources; preparing a questionnaire-brochure to acquaint both IDRES staff members and those in the broader riverine-estuarine community with the functions and services of the IDRES Information Center; and to learn about the responder's areas of specialization and his special information needs.

An Analysis of IDRES

IDRES was started by a $200,000 PSEF grant to The Franklin Institute, which acted as an administrative caretaker agency during the first year. PSEF then jointed the IDRES participants in successfully approaching NSF for an additional $75,000 to bring the first-year funding up to $275,000. With these resources the IDRES first year was funded. Subsequent efforts have produced the following:

- A $142,807 Federal Water Pollution Control Administration grant of which PSEF provided $14,280 in matching funds for continuance of the Wasteline Program.

- A $21,313 grant from the Bureau of Commercial Fisheries of which PSEF provided $4,500 in matching funds for the initiation of a study of Cation Exchange Relationships, Incipient Sediment Diogenesis, and Base Food Chain Relationships in Coastal Salt Marsh Environments.

- Funding by PSEF of up to $175,000 in a continuation grant to IDRES for the salary to a full-time IDRES director and partial funding of various second-year programs.

- Endorsement by PSEF of an IDRES proposal to NSF for about $100,000 in additional second-year funding.
- Proposals, still in consideration, to various of the mission-oriented agencies for further support of IDRES programs.

But what does IDRES mean to its members?

It must be recognized that many of the participants in IDRES had capabilities useful to the water resource spectrum of problems but lacked the specific credentials to win substantial support for their programs. Other participants had excellent credentials in some portion of the area but needed a broader orientation for best productivity. All have benefited from the constant IDRES communication at many levels (boards, working committees, trips, etc.). All of this intercourse has not always been completely harmonious but it has led to a strong association that can debate its way to a mutual position and then act in concord. The need for open airing of divergent viewpoints and the subsequent mutual education and refining of positions (frequently leading to consensus) has perhaps been one of the more valuable characteristics of the IDRES association.

Moreover, IDRES has served as a valuable interface between the research and academic communities and various relevant government organizations such as the Delaware River Basin Commission, the FWPCA (now FWQA), the Pennsylvania Departments of Health, Forests and Waters, and, of course, PSEF and the Office of Science and Technology. One of the many beneficial by-products of this interface has been the creation of a Priorities and Needs Committee to provide a series of yardsticks for relevance and funding-probability against which projected IDRES programs can be measured.

The initial thrust of IDRES (dictated by the urgent need for collateral funding) concentrated on a series of related programs each performed by its own institution and all united by the theme of conservation and beneficial utilization of riverine and estuarine water resources and their associated drainage areas. As the consortium matured, there was general agreement on the desirability of developing strongly multi-institutional programs. This has proven difficult for many reasons but is being pursued at a regular pace. Current IDRES subcommittees to develop multi-institutional programs exist in the areas of:

1. Mathematical Modeling
2. Dredge Spoil Management

Additional problems of current concern to IDRES are:

1. The development of viable mechanisms for bringing into IDRES regular support from nearby industry.

2. Expanding early successes with some mission-oriented agencies into a generally accepted, formalized technique for acquiring the support of these agencies. This need of IDRES is made most difficult at this time by the "research famine" of the past two years. This scarcity of research funds has been reflected in program cutbacks affecting the entire American research community and should not be news to any reader of this paper. It is regrettable that it has existed during this critical formative period of IDRES.

Since IDRES has been singled out for special recognition as a pioneer state-federal research and technology consortium for the remediation of regional problems, it is worthwhile to examine the IDRES nucleation and growth process. Such examination should be expected to highlight lessons of general utility in the development of analogous organizations, as well as problem areas that might be expected in the process.

To begin with, IDRES has been a combination by mutual consent of a non-profit contract research laboratory, two very different universities, a grant and endowment funded academy, and a consortium of small colleges. As might be expected, diverse opinions abounded at first on all issues. For instance, there was frequent controversy on the subject of joint programs. All members wanted these to develop; however, some felt that an initial proliferation of joint program nucleation efforts would be too complex and cumbersome to yield the required level of first-(or even second-) year funded support. This opinion prevailed and most IDRES first-year programs were performed by single institutions with frequent joint discussions and reviews. It is the author's viewpoint that IDRES would have failed had greater multi-institutional involvement been sought too early. Later efforts demonstrated that coordination of even something as mundane as working group meeting schedules proved to be difficult. (Tuesday, Thursday, Saturday teaching professors at first felt strongly that Monday, Wednesday, Friday professors should rearrange their schedules and vice versa; staff meeting days were considered inviolate; etc.) Familiarity and the growth of mutual respect seeemed to do much to remedy this problem.

Once working groups are constituted, each must be placed under a forceful and wise leader and compromiser as they have a way of becoming factionalized and (if not controlled) splintered. In a consortium nobody really has to get along with anybody else in order to stay employed; each is responsible only to his own parent organization, and when cooperative action becomes inconvenient or unprofitable it is a simple matter to retrench. This point begins to take us to the heart of the voluntary consortium matter.

An externally supported consortium must have a valid and economically viable raison d'etre. It must be far stronger in its subject area than the sum of the capabilities of its constituent organizations. (It is a simple [and frequently erroneous] extrapolation of this raison d'etre point to insist that all consortium activities should be performed by multi-institutional groups.)

Each member must have a valid reason for belonging to a consortium. Membership performance requires some submission to outside control and exposure to the possibility of splitting some potential revenues. If an organization feels that it is already nearly maximizing its long-range potential, and losing no desirable opportunities, it is a poor prospect for consortial combination, and will probably do little for the group if it is induced to join. In the interest of candor, one binding tie has been found to be money. All other things being equal, the consortium with access to some of its own discretionary funds is a better prospect for success than the consortium that is forced to prepare specific proposals for outside funding of each program that it wishes to undertake. A consortium must be allowed (even encouraged)to develop in capability. Forcing it to submit all of its programs (especially its new or ambitious ones) to competitive funding review by different mission-oriented agencies is one of the best ways to throttle consortial growth. There must definitely be outside management and review of all efforts and the rules of accountability for funds expended must be followed. However, all of this can be done either constructively or destructively and most of the process is beyond the control of the consortium; hence a consortium must have a benign patron (or group of patrons).

On the subject of control, there should be no ceremonial jobs in consortia. If a person is made head of some governing board he will ultimately be expected to govern. If he never intended to govern, or is really not the governing type, his impact could cause irreparable damage. If he governs well his worth can be enormous.

It is to be expected that the consortium will be directed or influenced in some ways through the action of one or more boards. In such cases the mandate and function of each board should be decided early and understood by all. It should not be expected that each board member will be as diligent in his attentions to the consortium (surprisingly, some are) as he is to his post in his parent organization. Boards should be constituted with this in mind. In any case, the best board is no substitute for a paid director and every effort should be made to provide for a paid, full-time director at the earliest possible date.

Problems notwithstanding, IDRES is viewed by its participating members as an experimental organization with a good chance to develop into a successful, permanent force for constructive activity. In recognition of IDRES' emergence from its period of infancy it has been formally recognized by both Boards and by PSEF that IDRES needs a paid, full-time director. The director will be paid initially, principally, out of funds voted by PSEF and will be housed and cared for administratively by Lehigh University. It is anticipated that this full-time director, reporting directly to the Policy and Advisory Board, will give to IDRES a drive and continuity of operations not achievable on a volunteer basis.

Section A: Air and Water Pollution

"Procedure for Developing Implementation Plans to Control Air Pollutant Emissions: A Review"--John C. Goodrich, Staff Consultant, Environmental Research & Technology, Inc., Research Associate, Harvard Graduate School of Design; James R. Mahoney, Staff Consultant, Environmental Research & Technology, Inc., Assistant Professor, Harvard University, School of Public Health; and Norman E. Gaut, Vice-President, Environmental Research & Technology, Inc.

I. INTRODUCTION

Man's activities, and especially the spatial and temporal distribution of these activities, produce dynamic patterns of air pollutant emissions. The concentrations of air pollution that result from these emissions, acted upon by the local meteorological and climatological conditions, increasingly affect man and his environment.

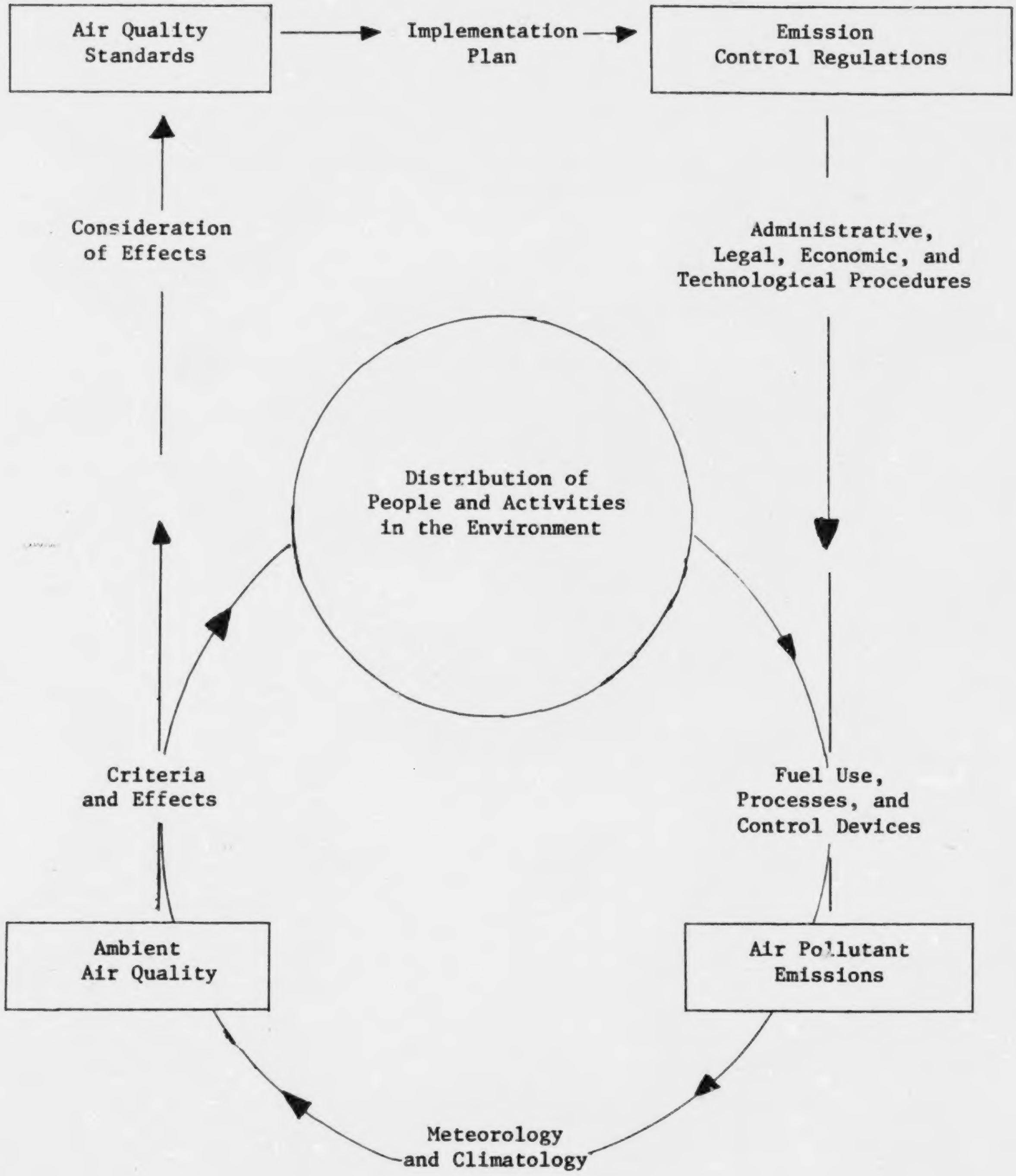
Clearly, we need to reduce the effects of air pollution and to improve air quality by operating upon the polluting activities themselves. What is needed is a detailed implementation plan to control air pollution emissions.

An optimal implementation plan designed to control atmospheric contaminants for a heterogeneous region is necessarily complex and difficult to formulate. In order to conveniently and efficiently approach the specification of the optimal plan, a systematic procedure of data gathering, strategy formulation, and strategy evaluation is needed.

There are five steps to the procedure of selecting an optimal implementation plan. First, there is a data gathering step. Second, the data is used as the basis to formulate various strategies, both for long-term control of pollution and for control of dangerous episodes of severe atmospheric contamination. Third, the strategies are tested for their ability to reduce air pollution to acceptable levels. Fourth, strategies which are capable of reducing the pollution level sufficiently are evaluated for their effect on the economy, their legal, technical and administrative feasibility and their equitableness as to who pays the additional costs of abatement. Finally, recommendations for the optimal plan are presented together with a surveillance system which is capable of monitoring progress and effectiveness of the strategy if it were to be implemented.

FIGURE I-1

THE AIR POLLUTION CYCLE


Air Quality Standards
Implementation Plan
Emission Control Regulations
Administrative, Legal, Economic, and Technological Procedures
Fuel Use, Processes, and Control Devices
Air Pollutant Emissions
Meteorology and Climatology
Ambient Air Quality
Criteria and Effects
Consideration of Effects
Distribution of People and Activities in the Environment

II. TASKS IN DEVELOPING IMPLEMENTATION PLANS TO CONTROL AIR POLLUTION EMISSIONS

I. CONTROL STRATEGY INPUTS

A. Air Quality Standards

Task 1: Translate existing air quality standards into a consistent base for comparison and evaluation.
Task 2: Format air quality data for input to computer graphical routines.

B. Current Air Quality

Task 1: Collect and evaluate available air quality measurements for reliability and potential utilization.
Task 2: Provide time-averaging periods for measurements corresponding to those used for air quality standards.
Task 3: Use advection-diffusion model to supplement available air quality measurements.
Task 4: Display available air quality measurements using computer mapping programs.

C. Emission Inventory

Task 1: Collect, examine, and filter source emission data available.
Task 2: Compile supplemental socioeconomic and planning information for region.
Task 3: Upgrade source emission inventory using supplemental information from data in Task 2.
Task 4: Allocate emission sources to a detailed grid for input to advection-diffusion model.
Task 5: Evaluate emission data from adjacent regions to aid in definition of background contamination levels.
Task 6: Present all pertinent information in graphical format.

D. Growth Projections

Task 1: Obtain population, industrial, and land-use projections.
Task 2: Select emission correlations to estimate future emissions.
Task 3: Identify technological changes and their effect on emission correlations.
Task 4: Project emissions for each selected time period.

E. Meteorological Data

Task 1: Obtain climatology data from an official local source.
Task 2: Obtain additional meteorological data from such sources as private airports and power stations.
Task 3: Perform an empirical-statistical study examining influence of local phenomena upon measurements to determine representativeness of data.
Task 4: Evaluate data relative to frequency of observation, missing data periods, and sample size to determine representativeness of data.
Task 5: Prepare data set to correspond to smallest time-averaging period of air quality standards.
Task 6: Perform appropriate statistical analysis on data to supplement climatology data.
Task 7: Prepare final regional climatology and pertinent meteorological statistics for advection-diffusion modeling.
Task 8: Present all pertinent information in a graphical format.

F. Available Control Technology

Task 1: Investigate the feasibility of using primary controls to reduce emissions of each specific air pollutant.
Task 2: Investigate the feasibility of using removal systems to reduce emissions of each specific air pollutant.
Task 3: Propose and document as to effectiveness and cost (men, material, money) various control techniques for the major sources of each specific air pollutant.

II. GENERATION OF CONTROL STRATEGIES

Task 1: Collect and standardize all inputs necessary to formulate long-term and emergency control strategies.
Task 2: Generate long-term control strategies to be tested for meeting air quality standards and for feasibility of implementation.
Task 3: Generate emergency control strategies to be tested for meeting air quality standards and for feasibility of implementation.

III. ADVECTION-DIFFUSION MODELING

Task 1: Adapt advection-diffusion model to a form appropriate to the region.
Task 2: Select representative "receptor" sites.

Task 3: Prepare a base map of the region for the computer mapping programs.
Task 4: Run the model using latest emission inventory data available for the region.
Task 5: Refine the model by comparing the results of Task 4 with available air quality data.
Task 6: Examine the effects of topography and local meteorological phenomena on the model calculations.
Task 7: Perform selective model calculations of air quality levels resulting solely from major point sources for input to strategy generation task.
Task 8: Perform model calculations on source emissions resulting from the strategies generated for long-term and emergency controls.
Task 9: Compare results from Task 8 to air quality standards.
Task 10: Prepare an explanation of the simulation modeling technique which includes the basis for the model, a discussion of the validating results, the assumptions made, and the limitations of the model.

IV. EVALUATION OF CONTROL STRATEGIES

A. Technical and Administrative Feasibility

Task 1: Determine technical feasibility of industrial control and governmental surveillance for each basic control strategy.
Task 2: Determine administrative feasibility of governmental surveillance and enforcement for each basic control strategy.
Task 3: Eliminate strategies which a preliminary examination shows to be infeasible.
Task 4: Assign costs (capital, operating, opportunity, etc.) for each control strategy to be quantitatively evaluated and include these in the economic objective function.

B. Political Feasibility

Task 1: Evaluate the political impact of basic control strategies on industry and residents.
Task 2: Determine the relationships, required by the control strategies, between state and local governments involved.
Task 3: Eliminate strategies which a preliminary evaluation shows to be politically infeasible.
Task 4: Evaluate the political feasibility in detail for low-cost strategies.

C. Legal Feasibility

Task 1: Examine state laws to determine how best to provide a preventive emission control authority and propose a carefully restricted variance system.

Task 2: Suggest a broad permit procedure for all agencies in the region.

Task 3: Explore ways of conferring authority to regulate directly the composition, allocation, and use of fuels in all agency jurisdictions.

Task 4: Examine alternative mechanisms whereby the regulatory authorities of each agency can be compelled to consider the effects of polluting activities within their jurisdictions upon the air quality of other jurisdictions.

Task 5: Study the need to provide civil penalties as well as the possibility of measuring all fines retrospectively from the date a complaint is filed.

Task 6: Draft an appropriate statutory authorization for preventive injunctions.

Task 7: Propose modifications in the emergency procedures of all agencies to provide for needed action in inter-agency episodes.

Task 8: Draft a constitutionally acceptable statutory procedure for the issuance of pollution-inspection warrants for each agency.

Task 9: Formulate specific strategies for adopting the needed legislative changes, and propose an optimal strategy.

D. Economic Feasibility

Task 1: Determine direct cost of implementing basic air pollution strategies (including control, surveillance, and administration). Formulate relations so that various combinations of basic policies can be determined readily.

Task 2: Determine indirect costs of each basic air pollution control strategy. These would include:
- the possible closing of some marginal plants and the related loss of production and employment (and the effects these have on the area);
- the effect of increased demand on scarce resources such as low-sulfur fuels and trained personnel;
- increased product costs, especially in the electric power industry.

Task 3: Determine the parties on which the cost of the air pollution control program ultimately falls. Determine the relative weights to be used for the cost burden of each group. Several sets of weights may be generated, reflecting various sets of social values.

Task 4: Determine discount rate to be used to convert future expenditures to present values.
Task 5: Consider economic costs of scarce resources to guide time-phasing.
Task 6: Formulate the overall objective function and include all quantitative constraints.
Task 7: Evaluate the objective function for each control strategy considered.

E. Timing Feasibility

Task 1: Determine the availability of current and future control technology.
Task 2: Determine the availability of trained personnel and the time required to train necessary personnel not presently trained.
Task 3: Evaluate the effect of budgetary limitations for capital expenditures.
Task 4: Determine the restrictions caused by time considerations and eliminate infeasible policies.
Task 5: Determine the best time-phasing for the given control strategy.

F. Ranking of Strategies

Task 1: Rank strategies by cost of the weighted objective function. This will also serve as the basis for a sensitivity analysis.
Task 2: Evaluate the low-cost strategies for administrative, technical, legal, political, and timing feasibility.
Task 3: If one strategy is clearly optimal, select it. If various qualitative factors must be compared to cost considerations, consult experts as required to select the preferred strategy.

V. RECOMMENDATIONS

Task 1: Recommend emission control regulations for each specific air pollutant based on an optimum control strategy.
Task 2: Recommend a time schedule for implementing the controls called for in the optimum control strategy.
Task 3: Prepare recommendations for an optimum emergency control procedure to be used during short-term high pollution episodes. The recommendations include a surveillance system, a real-time data interpretation and display system, criteria for identification of alerts, and control actions necessary to maintain acceptable levels of contamination.

Task 4: Prepare recommendations for a surveillance system including meteorological, air quality, and source emissions monitoring.

Task 5: Prepare recommendations to modify, strengthen, or remove statutes in the region to permit the agencies to enforce requirements for the orderly application of control techniques set forth in the implementation plans.

Task 6: Document the resources required to carry out the implementation plan.

Section A: Air and Water Pollution

Chairman: Frederick J. McKeown, Assistant to the Chairman, New York State Pure Waters Authority

Recommendations

1. It is recommended that regionally based "thrusted consortia" of scientific and technologically oriented institutions be established regions. These institutions might be universities, non-profit research institutions or research and development arms of industrial firms. Each multi-disciplinary consortium should be focused on a single problem theme. These consortia should have as their goal the regional solution of important problems in their area. Each consortium should be "grubstaked" with *non-mission*-oriented funds programmed to decrease to a low level over a period such as, say, five years, during which time a goal should be the development of a base of support from relevant *mission*-oriented sources.

2. It is recommended that the broadest efforts, both public and private, be devoted to acquiring, and passing on to the public in terms comprehensible to laymen, information on the following questions related to the environment:

   a. Causes and effects of pollution.

   b. The current status of abatement efforts.

   c. The costs and trade-offs for different strategies and levels of effort.

   d. The state of knowledge and progress being made on control techniques.

Public agency authorities do and should respond to public pressure in social areas. For this reason it is particularly important that the government and/or scientific communities not set out to decide an optimal strategy for meeting environmental problems behind closed doors, because it is likely that such a strategy will not be accepted by political decision makers or the public, or even understood. In fact, the value considerations which enter into deciding who should receive what benefits, who should pay and how much, and when such benefits should be sought are appropriately the subject of the political decision-making process, even though analytic techniques have much to contribute in identifying and clarifying those considerations. One of the most important roles of scientists, therefore, is to provide the public with accurate, complete, and specific information and education, so that the public pressure which demands action will not be a mindless panic which wastes money while leaving critical problems unsolved and perhaps even unidentified.

3. It is recommended that research allocation modeling should be undertaken to identify optimal strategies. There is now and always will be severe competition for the limited research funds available, competing demands for present versus future-oriented efforts in pollution control, and different needs and capabilities for research at the federal, state, and local levels. In recommending that such modeling be done, it is recognized that it involves value judgements which are, in many cases, the proper subject of a political decision. Consequently ways must be developed to involve the public in decisions which vitally affect them in this area.

4. It is recommended that mechanisms be created for creating and maintaining an operating interface between people in state and federal government and persons working in research and other technological areas to promote and sustain a continual dialogue on socio-technological problems of interest, and that publicity concerning research opportunities which are directed toward the technological resources in particular regional areas be given the broadest possible dissemination.

Dr. Melvin B. Zisfein, Associate Director of the Franklin Institute in Philadelphia, Pennsylvania, described how the Institute for the Development of Riverine and Estuarine Systems (IDRES), was formed. As the result of a chance encounter in 1968 with Pennsylvania state officials aware of the availability of research funds from the Pennsylvania Science and Engineering Foundation (PSEF), Dr. Zisfein was asked if the Franklin Institute would be interested in performing some studies in the water resources area. The Franklin Institute contacted other institutions (Lehigh University, the Academy of Natural Sciences, and Temple University) which were thought to be interested in forming a research consortium area. The institutions drew up a proposal for such an organization--IDRES--and submitted the proposal to PSEF, then initiated contact with the National Science Foundation (NSF) for the purpose of obtaining additional funding for the project.

Beyond the specifics of its research, IDRES served to bring various research institutions together in a working relationship, and thus developed a capability that was to prove stronger than any of its parts. IDRES' initial effort was to have each member institution do what it did best, by itself. The attempt to achieve instantaneous group interaction and cooperation is very appealing, but realistically it is probably essential in most cases that this not be attempted. It is necessary to get money from somewhere. An organization must begin producing visible results right away, to insure that its funding does not dry up before it gets off the ground. IDRES' advisory boards contain members from relevant governmental bodies in the region (e.g., the Federal Water Pollution Control Administration, the Delaware River Basin Commission, etc.) and industry. Dr. Zisfein noted that IDRES had solicited funds from both mission- and non-mission-oriented sources. Initial support from non-mission sources provided an opportunity to demonstrate the consortium's research productivity, which could then be used to support requests for funds from mission-oriented agencies. IDRES also found that letters of endorsement were helpful in obtaining governmental funds. In summary, IDRES was held to have served as a vehicle for communication, cooperation, and coordination between various private interests (for example, industry), government, and research groups to deal with regional problems of common interest. Finally, the consortium had attracted into the region federal funds to assist with regional problems.

Dr. James Mahoney, assistant professor of applied meteorology, Harvard University, then gave an overview of the governmental efforts in air pollution control. The Federal Air Pollution Control Act of 1967 forces interaction between the federal government and the states --an arrangement which has both advantages and disadvantages. The first step required under this legislation was for the Secretary of HEW to promulgate a document for each pollutant and to proscribe the levels of that pollutant in the atmosphere which adversely affect health. The federal role is, thus, to define pollutants, emission levels, and the technology available to combat pollution. The states were then given the enforcement responsibility. Once the federal government has promulgated the air quality criteria and control technology, the states must, within ninety days, notify the Secretary of HEW of their intention to set state standards in conformity with the federal criteria. Within another 180 days, the states must submit their standards. If the federal government accepts these standards, the states must then submit an implementation plan--a timetable according to which specific polluters will be required to attain specified cleanup requirements. Dr. Mahoney noted that the planning approach represented by this philosophy was in contrast to another approach which is frequently advocated in the field. This other approach is to take the knowledge presently available and to eliminate most of the current pollution by going after the big and visible emitters. He identified the planning vs. "crude" regulatory approach as a question which deserved further consideration. Many states are behind the schedule designated in the bill because of manpower shortages. Standard setting was held to be proceeding very unevenly, with some states doing well while others lagged far behind. One aim of the federal effort was to create, in those states which did not have it, an administrative body--or the embryonic beginnings from which such a body could spring--concerned about and working on air pollution problems. In this regard, the air pollution act has been successful. At the same time, however, many state Air Pollution Control Agency directors claim that the diversion of manpower to planning which the standard setting effort has required has slowed their efforts in the more obvious types of enforcement. Dr. Mahoney identified what he felt were the most critical needs in the air pollution control area:

1. The meteorological data base for air pollution control planning is insufficient. Even in large metropolitan areas, measurements are taken at only one location (usually at the airport).

2. Because most of the agencies are associated with state government, there is little planning on a regional level.

3. A better level of public information is needed, including such facts as the costs and trade-offs for pollution control. The state agencies might consider putting together a public document to provide information in this area which the public can understand and use. The benefits of putting out such a document would be first of all, of course, the education which the public would receive, and, secondly, the increased contact which would result between the emitters and the control agencies. In many cases the problem is simply that many emitters do not know what they can or are expected to do.

The issue was raised of the efficiency of the current allocation of research funds between federal and state agencies. State people, it was observed, sometimes claim that federal research is not applicable to local problems. Dr. Mahoney agreed that the common complaints from state people, are, first, that there is no money available, and, second, that at their elementary level of sophistication, the research done by the federal government is often too complicated for their use, or is applicable only to a more advanced state of pollution control. Dr. Mahoney pointed out that while research may be done in many different locations, states must take operational responsibility (i.e., for implementing the results of research--for example, in enforcement) in their jurisdictions.

In response to a question about whether there would be a more efficient use of federal research funds if more research was done on the local level, Dr. Zisfein said that he did not know but he suspected that if a study were made, it might produce some shocking results. For instance, it might show that the best allocation of resources would be for the federal government to carry out ALL the actual "research" and for the states to be given money only to discover such things as how to better install secondary treatment plants (for treating wastes prior to their discharge into the water). Since no one at present knows what the most efficient allocation would be, it was suggested that a "good job of research allocation modeling be done." Dr. Zisfein commented that it was possible that the results of such a study might shock the research community. Dr. Mahoney commented in return that while most R & D will continue to be done at the federal level, more funds are needed at the state and local levels to transfer theory to engineering usefulness. At present a "pittance" is allocated to air pollution in R & D, and just a fraction of that is for "demonstration" projects. It was pointed out in response to Dr. Mahoney's comment that the problem so far has often been that the local people charged with control responsibilities do not have an adequate understanding of the problems they confront or of the techniques available to meet them. If local people never get to deal with the problems on a theoretical level, but are confined to engineering or hardware projects, they will not understand or know how to operate the sophisticated techniques that will be generated by R & D.

The "boom or bust" nature of the federal government's actions concerning air pollution was also held to hinder the development of adequate professional capabilities. There are sporadic needs for consultants and then long dry periods in between. This creates manpower shortages when manpower is most needed. The training of people to meet a problem once the parameters of that problem are fully specified is not sufficient, because of the lag time required to get people through university programs, etc. It was suggested that to meet both these problems (i.e., the periodic shortage of consultants and the shortage of trained personnel generally) large grants of funds be provided to support a program of on-the-job training for local people, so that they can continually up-date their professional capabilities.

Although efficiency was in most cases a desirable objective, it was argued that the nation had wasted resources in pursuit of our space and defense objectives and that it was more important to immediately attack our pollution problems, albeit inefficiently, than to wait until some "optimally efficient" solution had been found. Chairman McKeown suggested that we have to pursue short-term measures at the same time we are doing long-range planning and hope that what we do in the short run does not turn out to detract from what we eventually learn we must use as a long-run solution.

The fear was expressed that unrealistic quantitative measures would be attached to cleanup benefits, particularly in estimations of present versus future values. Value judgements were considered to be an inherent part of policy formulation. The view was expressed that those judgements be made by the groups most immediately affected through the political process. It was pointed out that it was preferable to have the value consideration explicitly identified. Resource modeling (including the value decisions) was viewed as a difficult but essential input into policy formulation. The need for involving the public in the decision-making process was emphasized. Pollution agencies respond to public pressure. The most urgent need in the pollution area is public education--so that the public "demands the right things," and does not charge off and waste money on the wrong demands or inhibit through legislation technological changes which, more "objectively," are beneficial, on balance.

Air pollution was held by some to be significantly less important than other of America's domestic ills, e.g., malnutrition and rat bites. Focus on air pollution to the exclusion of these other problems reflects mistaken priorities. Chairman McKeown pointed out in response that pollution causes more deaths, in all economic groups, than the rats do. It is important that we learn to consider not just, say, air pollution or water pollution as separate problems but as interlinked parts of an ecosystem. Another cautionary note was expressed. Scientists are making a grave mistake concentrating on developing "control" techniques. The effort should be going into considering ways to use our resources so that we do not emit pollutants and into ways of reusing "waste" materials.

Industrial researchers were beginning to be aware of this need. Also stockholders are beginning to question their companies about expenditures for pollution control and viewing them in a favorable light, whereas, before companies had to either cut out expenses for pollution control unless they were incurred at the demand of a regulatory authority or at the very least apologize to their stockholders for such expenditures.

Section B: Program Planning and Management

"Mechanisms for Resource Allocation and Evaluation"--Selma J. Mushkin, Project Director for Studies in State and Local Finances, The Urban Institute

Effective use of resources by the governments in the interest of the consumer-voter is the purpose to be served by improving the tools of resource management. And making better use of the funds that are available is precisely what current efforts toward implementation of integrated systems of planning, programming, and budgeting are all about.

A PPB system sets in motion a process through which, as a routine of government, the question is asked: How better--i.e., more effectively and efficiently--can available resources be allocated among competitive uses?

The system requires: (1) that the ultimate goals or objectives of each activity for which a government budgets money will be clarified and specified; (2) that contributing activities will be gathered into comprehensive categories or programs to achieve the specified objectives; (3) that a continuous process of examination or evaluation will be carried on as to the effectiveness of a program, as a first step toward improving or, if necessary, eliminating it; (4) that any proposals for new programs or for old program improvements will be analyzed to see how effective they may be in achieving program goals; (5) that the entire costs of each proposal will be considered not only for the first year but for several subsequent years; and (6) that a plan, based in part on the analysis of program cost and effectiveness, will be formulated for budget implementation.

Basically a PPB system is a unifying and comparing process. Optional programs are compared in terms of their accomplishments in meeting objectives and their costs--both those that are immediate and those that are implicit--for subsequent periods as a result of the immediate action. The comparing process demands a search for alternatives--a search that could encourage consideration of new technology and social invention.

The application of improved mechanisms for resource allocation has become more important as decisions on state and local expenditures have been separated from decisions on taxation. Federal grants to the states now account for $1 for each $2.80 of a state's own revenues. In some states, less than $2 is raised by the state for each $1 of aid. Tax raising forces a public discussion of local expenditure decisions; when external funds are used, substitute methods for control and choice of programs are needed. While a large share of the resources for civilian programs is raised by the states and localities directly, where intergovernmental cooperation is involved, and federal aid is extended, the purposes sought by the national government can only be achieved with the active cooperation of the several levels of government. Improvement of resource allocation, including allocation of the federal tax dollar, rests on improved management of resources in the states and localities.

In the pages that follow we ask (1) what is the current status of PPB implementation in state and city, and (2) what are the steps that need to be taken to extend the use of and improve the quality of analysis in state and local program and budget decisions.

Extent of Application of PPB

Beginning in January 1966, a few short months following the August 1965 directive to federal agencies by the President on PPB installation, a few states met to consider a demonstration project on PPB implementation. In subsequent months, the 5-5-5 project was developed in which five states (California, Michigan, New York, Vermont, and Wisconsin) joined together with five counties (Dade, Nashville-Davidson, Los Angeles, Nassau, and Wayne) and five cities (Dayton, Denver, Detroit, New Haven, and San Diego) to test the feasibility of PPB adaptation to state and local government use.

The progress that was made during the demonstration year encouraged many other local governments to begin PPB system installation. By 1968, over half the states and almost sixty cities or counties reported that they were taking steps to implement PPB systems. Since that time, additional governments have taken initial steps.

Approaches to PPB

A review of the steps toward initiating PPB implementation in the states and cities indicates two general approaches. The first approach was taken by most of the state and local governments. The second is possibly best represented by New York City's effort. For purposes of contrast, the approaches may be labeled (1) incremental and (2) systematic. However, the difference between the two approaches is more a matter of gradual shading than of sharp contrast.

In most of the state and local governments, the initial "incremental" effort has had the following characteristics:

1. The chief executive of the jurisdiction gave his formal endorsement, but not a strong supporting hand.

2. The PPB budget and the analytical staffs for implementation were small.

3. Experienced analytical staffs were not recruited.

4. Implementation was heavily dependent on training of staff already working for the government.

5. The effort was supported and nurtured by the career professionals with due caution, and steps taken were faltering.

6. Line-agency cooperation became essential, but was difficult to attain on what was almost a voluntary basis.

7. The timetable for implementing the procedures was a long one.

In the "systematic" approach, typified in New York City, the Mayor determined that PPB would be installed. Recruitment for implementation and placement of central staff were also essentially determined by the Mayor's direction. The city's commitment to PPB was relatively large. Resources allocated probably approximate the total of those of all other local governments combined. The approach has had the following characteristics:

1. A strong commitment was made by the chief executive.

2. Sizable staff resources were provided for analytical efforts, and considerable emphasis was placed on recruitment of new talent.

3. Some experienced staff was recruited, and new staff was trained on the job.

4. A link was made with RAND of New York to carry out analytical studies in at least four areas--housing, fire prevention, police, and health and hospitals.

5. The staff was largely new to the city government and enjoyed the excitement of a new adventure.

6. The timetable for the showing of a payoff was brief.

Clearly, the commitment of the chief executive is an important determinant in any approach. On this commitment depends, at least in part, the size and scale of the effort and the relationship with departments of the city government. Small-scale incremental efforts become heavily dependent on career professionals and their relations to each other. Philadelphia, for example, started down an incremental path toward PPB implementation that contrasted sharply with that of New York City. Whereas New York's PPB was initiated by the Mayor and moved forward with his active involvement and support, Philadelphia's was originated by the professionals in government and was furthered largely through their cooperation at central and agency levels. Gradual development of the system was sought step by step with the build-up of staff capability through periodic training and orientation. The first products were structural--the development of an output-oriented classification of programs, subprograms, elements, and subelements. To assure that the structures developed by the agencies would have an overall rational relationship to each other, general agreement on a broad basic program framework for the entire city government was reached initially between the Department of Finance, which housed the central staff for the PPB effort, and operating agency officials. From its beginning, Philadelphia's PPB system was grounded in agency cooperation.

Analysis in Philadelphia was, however, undertaken on a hesitant, trial basis. First directed to the venereal disease program in the Health Department, it was subsequently broadened selectively and for a long-run developmental program. In contrast, New York City started down the path of program analysis with a large effort to demonstrate a short-run payoff from analysis to gain public support of the Mayor's undertaking. Accordingly, at least at the outset, much emphasis was put on reducing the costs of programs while maintaining their effectiveness.

Whatever the focus on program structuring, it is clear that the central core of the PPB system is analysis of cost and effectiveness of alternative ways of satisfying specified public objectives. With analytical talent in short supply, the energies devoted to refinement of structure can detract from analytical efforts. While New York City concentrated its PPB work on program analysis, with a number of analytical studies made by the staff of its Bureau of the Budget buttressed by a joint effort with the RAND Corporation, the city undertook subsequently to institutionalize PPB work through preparation of a program structure and setting up "program definition statements."

In discussing this phasing of the work, the problem posed by a city official was:

> the real danger that we will lose the substance in the process of installing the form. . . . We have from the beginning operated . . . on the assumption

> that it was analysis which was of primary importance and that we could establish the formal trappings of PPB only after we had established a capability for, and a credibility of, an analytic approach.

Although considerable progress has been made at implementing PPB systems in state and local governments this process has been slow. Moreover, many barriers exist to more rapid and extensive installation of the analytical procedures of PPB. The listing of barriers below is followed by recommendations or proposals for new national action.

1. The lack of assured funding of PPB system application in the states and localities.

2. The failure to take concerted action toward assisting in recruiting and training of analytical personnel for work in states and cities.

3. The hesitancy of technical support of state and local analytical efforts by federal agencies.

4. The partial and uncoordinated approaches to evaluation.

5. The lack of adequate data for identification and measurement of outputs of public programs and costs.

Proposed National Action

One: A proposal for a federal specific purpose grant for installing integrated systems of program design and management by objectives in states, cities, and counties.

Despite the number of planning grants that are now available to state and local governments, there is no grant on a formula basis that makes an offering of funds to all the states and the major local governments; such offerings could be used for installation of improved techniques of program design and management. Prompt consideration should be given to the adoption of a new and additional grant, on a matching basis, that would go for a central staff unit as determined by the governor, mayor, or chief elected county official. Specifications for such a specific purpose grant have already been developed as part of a study undertaken by the State-Local Finances Project for the U. S. Bureau of the Budget.

These specifications do not deal with financial incentives for, and the funding of, analytical staffs for state and local *legislative* bodies. Such staffing could have a decided impact on the quality of budget and program decisions. From the outset of the PPB demonstration in state, city, and county, emphasis was given to the meaning of PPB for the state legislature and how analytical procedures could assist legislative bodies. Perhaps the best way to get the legislature to urge and fund PPB in the executive branch of the government is to show its usefulness in the legislative branch.

Two: *A proposal for a joint study by the state and local personnel agencies and the U. S. Civil Service Commission of staffing aspects of PPB under the auspices of the Executive Offices of the President, and the national organizations representing state and local governments, e.g., the National Governor's Conference*.

Such a study should be addressed to (a) any additional statutory authority required to encourage and permit exchanges of analytical personnel between national government and states and localities beyond that proposed by the Intergovernmental Personnel Act sponsored by Senator Muskie, and that authorized by the Intergovernmental Cooperation Act of 1968; (b) problems of training by the U. S. Civil Service Commission, or universities selected by that Commission, of state and local officials in PPB techniques using federally appropriated funds for such purposes; (c) methods of encouraging and obtaining the required funding level for the U. S. Civil Service Commission to carry out the new tasks; and (d) statutory authority and funding required for the U. S. Civil Service Commission to provide technical assistance and personnel to state and local personnel agencies.

PPB viewed as a policy-informing instrument is essentially a staff product and process. How do the states and localities obtain the required staff to do analytical work? Few state and local governments have salary scales that permit recruitment of highly trained analysts. Temporarily, at least, partial substitute methods have to be found. New avenues of recruitment are needed to attract young persons into state and local government. Training programs have to be developed and used for existing staffs with some analytic capacity. The supply of qualified persons needs to be greatly enlarged for the longer run. Pay scales of state and local governments must be made competitive for these personnel.

Three: A proposal for strengthening national support and encouragement of state and local analytical efforts.

A central agency of the national government should undertake directly or through the instrument of a third party to (a) provide technical assistance and personnel support to states and local governments in carrying out analytical and evaluative studies; and (b) coordinate the analytical assistance provided by the departments and agencies of the national government that are responsible for cooperative intergovernmental programs, such as the Department of Health, Education, and Welfare, and the Department of Transportation.

The work that has been initiated needs to be strengthened considerably, and enlarged, with clearer concepts of appropriate intergovernmental relations in a federal system. The buildup of technical capacity for analysis in the states and localities, and technical aid by the national government in this buildup, have to be separated clearly from the decisions on program and priorities that belong to the states under the Constitution. Such technical assistance should be designed as a support of state decision-making rather than a substitute for a state's own decision. Because of the narrow line between federal technical assistance and federal encroachment on the sovereignty of the states, a third-party instrument would perhaps be preferable to direct national government involvement in technical assistance teams. However, the amount of resource commitments required to gain a firm institutional pattern of technical assistance is large and perhaps beyond the resources that could be made available to a third party.

The national government cannot neglect its interest in intergovernmental programs, nor can it set aside the expertise that it is accumulating through the analytical approaches being followed in the federal agencies. Expert analysts from the functional agencies of the national government can provide specialized skills and information to the states and local governments. This expert assistance is an important ingredient in any technical assistance effort that is worked through.

Four: A proposal for evaluation requirements in all federally aided programs.

Evaluation requirements under intergovernmental programs have contributed importantly to new procedures for resource allocation in states and local governments. In fact, there is some reason to speculate that the anticipation of federal requirements for the application of cost-effectiveness analyses has encouraged some local governments to start down the path of PPB implementation.

Evaluation studies by cities and states that assess the results of programs have become vital to the national government in its undertaking to achieve its purposes through financial assistance to states and cities. The problem of managing federal responsibilities in areas such as urban renewal, community development, crime control, juvenile delinquency prevention, and education through decisions taken by states and communities clearly requires that localities institute procedures for evaluation to provide the data needed by the national government. But such evaluations, if they are to have an impact on the decisions of the local governments, must be built into a machinery for the decision-making that is specific to each government's own process. Essentially this means the development of processes of program planning and budgeting in state, city, and county.

We may expect in the months ahead that an increased use will be made of evaluation requirements in federal grants-in-aid--or requirements that demand of communities an assessment and quantification of the effectiveness of the federally aided programs in achieving the objectives set. Revision of federal grants-in-aid to require program evaluation could perhaps be achieved faster by administrative regulation than by statutory change. If such administrative regulation is not in accord with congressional authority, appropriate amendment of the Intergovernmental Cooperation Act of 1968 could be designed that would apply to all grant programs. Grants might be enlarged to finance the evaluation studies, or, within the allocations made from sums appropriated, evaluation costs could be counted as a necessary expense of administration. For the seven federal programs that carry specific authorization for the use of between one-half of 1 percent and 1 percent of the program funds for evaluation, the question has already been posed of use of a part of the funds for state and local evaluation.[1]

Five: *A proposal for enlarged federal research and data collection on program outputs and costs.*

The analytical process sets in motion inquiries about the purposes of state, city, and county--that is, inquiries on what is the government trying to do, for whom, and why. These are inquiries that kindle an awareness of government as a producer or provider of products for the people. It is no small wrench for government officials to begin asking questions about the products for people--

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[1] Jack W. Carlson (1969) "Federal support for state and local government planning, programming, and budgeting." In U. S. Congress, Joint Economic Committee, Innovations in Planning, Programming, and Budgeting in State and Local Governments. 91st Cong., 1st sess. Washington, D.C.: U. S. Government Printing Office.

for example, opportunities provided for learning, changes made in health status, the housing conditions that are fostered, protection provided for persons and property, the extent to which an advance from poverty can be achieved, the recreation and cultural opportunities furnished. Officials who have long been accustomed to the routine of comparing expenditure levels and manpower inputs into public services, when suddenly required to examine the quality and quantity of public products in terms of end products rather than processes or inputs, discover many lacunae in knowledge about such products, their nature, and their magnitude. The yardsticks for that type of measurement are often not in the batteries of statistics which state or city statistical offices or agencies have formerly produced.

The national government's interest and concern with intergovernmental programs that extend over the wide range of state, city, and county activities suggest that the national government take a larger measure of responsibility in gathering data required for assessing public programs and for financing or undertaking the research required with respect to program operations and results attained.

There are clearly economies of scale to be attained in national collection of data and national support of research. The U. S. Bureau of the Census has taken steps to discuss with state and community officials cooperative work on data collection. The beginning efforts that have been made need to be vastly enlarged.

Such intergovernmental cooperative efforts in gathering statistics, buttressed by work on defining in a uniform way small program elements and collecting information on sources of funds for each of the elements would help to fill important data gaps.

The national government, as it has perceived the needs for data to assess its own expenditures, has fallen back on the state and local governments for information. The approach of the national government has been to encourage data collection in the local governments, and uniformity in this collection. In the process of seeking this uniformity, the national government has in a few instances yielded to the temptation of encouraging uniformity in definition of program goals. This temptation to encourage replication at the state or local level of a federally designed program structure is strong. A uniform national and state structure would tend to produce as a by-product statistics consistent over the nation and would open up the potential of program analysis within common definitions of public purposes and measures of output.

The temptation to issue directives and impose requirements that can yield uniformity and comparability endangers the gains that are possible to local government when it undertakes its own exercise of setting goals and of comparing programs relative to effectiveness and costs, both as to expenditures and opportunities foregone. Especially important for local governments and the states in a federal system is an independent search for alternatives within the processes of program analysis. In fact, the routine of analysis requires such a search, and opens the way for the inventive public employee to inject new approaches into the program assessment. An inventive program proposal, as a minimum, would be assured a more prompt consideration as an inventive alternative in the course of analytical study of an issue.

Communication Channels Among Governments and Between Universities and Governments

Start-up problems in PPB implementation in states and cities have by now been documented and the comparative experience has been reported. But as the governments advance in their efforts, there is more need for organized communication channels on program structures, on program analyses, and on evaluations completed.

Universities are engaged in research that has an application to governmental problems. They have the expertise for bringing together specialists who can contribute to the understanding of city and state problems and ways of meeting them, but the results need to be translated (by the universities) so that the research can be understood and judged by the layman. Publication vehicles usual for university scholars are not, in the main, customary reading materials for city officials, and the language of scientific journals is not always clear to the layman.

In addition, a reverse flow of communication from city and state to university could serve an important research purpose. The problems as perceived by the state and city are many and offer a field of research study that can provide the hypotheses for investigative study. Many researchers are seeking problems to investigate; jurisdictions with the problems seek information and research findings.

Several recent institutional arrangements have been designed to develop or foster new communication channels. The Urban Observatory project under the direction of the National League of Cities specifically aims at generating partnerships between cities and universities. The concept calls for creating coordinating organizations that can (1) focus university resources on the problems of metropolitan governments; and (2) undertake research on matters of particular concern to local communities. The Urban Institute, established in 1969 as an independent, nonprofit research organization, has the basic mission of exploring the whole complex of urban problems as an aid to federal policy formulation. It constitutes a de facto channel for communication between national and local governments and between governments and the university research community by (1) building on university research already completed; (2) undertaking major studies indicated by existing deficiencies in knowledge; and (3) working with cities to improve their management.

Communication among governments and universities can be furthered by other similar or additional institutional arrangements. Clearinghouse activities on research are, in fact, being fostered by several federal agencies, each of which is concerned with special areas.

Section B: Program Planning and Management

"PPB in New York City"--Brenda Feigen Fasteau, Formerly Chief Analyst, Boston Redevelopment Authority

Generally, PPB is an attempt to introduce a formal structure into decision-making. In summarizing my paper, I would like to focus on two city agencies--one a complete failure and the other a relatively good example of successful PPB implementation.

The Human Resources Administration is the largest and possibly the most important of New York's "super agencies." Why did it fail? The Bureau of the Budget (BOB) has an excuse--they say it was due to "human problems." But that is not an excuse. Two real reasons for the failure were (1) that there was actually very little known about agency goals, objectives or, for that matter, operations (this fact has since been admitted by BOB personnel); and (2) that there was little agreement among key personnel (agency and BOB) about the overall goals of the agency and programs to implement those goals.

The Police Department, on the other hand, was fairly successful. The PPB effort can correctly be said to be at least partly responsible for the following new or changed programs:

1. "Civilianization" of office personnel.
2. A police trainee program.
3. Expanded patrol and the fourth platoon for high crime (6 p.m.-2 a.m.) periods.
4. Effective patrol units (one-man cars in low crime areas).

The major problem with the whole PPB effort was that BOB didn't appreciate the need to know and understand what was going on.

They needed to know the bureaucratic power politics, the information flow, and many other aspects of agency operations. Without this kind of knowledge, ideas are formed in a vacuum.

Measurements of success are important, yet were not emphasized. The Mayor did not develop a way for PPB to enter the system of policy and political effectiveness determinations. BOB did not insist on agency measures for past and future programs. (This helps explain the better record of the paramilitary agencies, where measures of success are fairly straightforward and easy to quantify.)

The failure of HRA, by the way, cannot be dismissed as "just one failure" among many agencies. Its size and importance preclude this. Its welfare component alone is sufficiently large to dwarf many other "super agencies."

Another aspect which came out clearly was the effectiveness of the rewards and punishments system in the paramilitary agencies--and the singular lack of same in HRA and other agencies. BOB could and should have looked at the question of how to make civil servants more responsive.

I do not approve the government-wide approach which, after two years, is what BOB ended up with. Limited resources would have been better used if concentrated in a few agencies. New York did succeed, through PPB, in getting some good people into the agencies. The effort also brought about a reviving of BOB itself, with generally salutary results. And it got some civil servants at least to think about rationality and analysis.

Section B: Program Planning and Management

Chairmen: Robert Marden, Director, Massachusetts Office of Planning and Program Coordination

Robert Casselman, Director, Modernization Systems Unit, Massachusetts Office of Planning and Program Coordination

Recommendations

1. That the federal government continue and expand support of states and local governments in that facet of research and development implementation which has been termed Planning-Programming-Budgeting (PPB).

2. That the United States Bureau of the Budget take a much stronger role in commissioning, collecting, and disseminating hard-headed evaluations of federal, state and local experiences in this field.

3. That there must be more effort to secure the views of the consumers of public services on their relative priority rankings of new or expanded services, and on their relative satisfaction with the services delivered.

4. That no federal grant-in-aid program require a precipitate or total adoption of some version of PPB, in the present uncertain state of the art, and the limited staff experienced in applying these techniques.

5. That state and local governments, with the financial support of the federal government, should draw upon the talents of universities in informing chief executives and legislative bodies about scientific advances, new technologies and research findings

and assisting in assessing the public policy implications and uses of such scientific advances.

Policy Questions

These are questions raised on which no consensus was forthcoming or sought, but which were considered very important.

1. How can we decide what level of resources should be invested in two types of research and development activities:

   a. on public management, as such, and

   b. on the technical R & D aspects of various public services covered in other sessions of the conference?

2. At what level of government can R & D funds most profitably be invested, and in what types of units?

3. How can we make the analysts engaged in the PPB effort at state and local levels continuously aware of the public and political environments within which they must apply their talents?

4. What are the most effective modes for introducing the PPB or related approaches into state and local governments?

Mr. Marden: While we're settling these analytical and procedural questions, is there not a danger that this fast-moving world will pass us by? As this workshop is going on, others on more functional or substantive issues are also taking place. Can science and technology help planning and PPB systems directly, or are we discussing how best to introduce them to the substantive areas? What are the barriers and the prospects?

Mr. Corbett: A point should be made about both cases. In each, there is a shadow "lurking"--the legislature in Massachusetts and the political information system in New York--which can distort the picture and which must be satisfied in addition to the chief executive.

Mrs. Fasteau: In New York this was reflected by the Mayor's definite acquiesence in, not true commitment to, PPB. He felt it could be used to help him guide his agencies down his political track.

Mr. Casselman: With any system, at the very least, should come the knowledge that there is better and more knowledge on a given subject. If it does that, then it reduces the chances of political manipulation of decision-making.

Mrs. Mushkin: State legislatures rarely take the initiative in PPB; they could. PPB experiences at the state and local levels did not match the federal.

Mr. Marden: People working in these areas should be aware that they can provide better information to decision-makers, and thus perhaps narrow the alternatives or give direction, but they cannot preclude political decision-making.

Mr. Bower: Mrs. Fasteau said that real benefits came in New York because through PPB Lindsay got some decent people into the agencies. If so, it's not an information system, it's a personnel system. She said it also introduced analysis into decision-making, but not enough because Lindsay hadn't thought his political situation and options through. We tend to lose sight of the "power games" which are played with everything, including PPB. Many, for example, see the original implementation by McNamara in Defense as a massive mistake--its real result was to unite the services, so you can't play them off against one another any more.

We must face the fact that our government agencies are composed of large numbers of people who have a great deal of inertia. We need new people, Mr. Casselman; we can't do anything without them.

Mr. Casselman: At one time I shared your stereotype of state employees. But no longer--I find them as competent as those I knew at Polaroid, from whence I came. In light of the massive frustrations they face, their commitment may even be stronger. To say we have to wipe out the old guys and bring in us smart-heads is arrogance of the highest order.

Mr. Slavet: Political leadership is the key. Lindsay identified PPBS with a new breed of people he brought into his administration. But as the election approached he shifted from that large group (feeling it would be bad to be identified with them) back to close allies and to the political system.

The top guns of the HRA during the PPB era were rational and intellectual--not the type to fight or even ignore PPB unless they knew there was no real mayoral commitment. Mayors, quite understandably, don't want effectiveness measures put on the public record.

Mr. Marden: Political leaders are definitely doubtful about defining too closely what dollars are spent for. Many don't want this measured. But demands for public dollars are so far exceeding supplies that the old method--greasing the squeaky wheel--is no good any more.

Mr. Casselman: Measures are another hang-up. Some things cannot be measured. But the program manager and his boss can agree that there shall be certain outputs to look at.

Mr. Williams: This dialogue illustrates the paradox of PPB--a decision-maker who when instituting PPB demands more precision, must "cop out" when he sees precise measures of effectiveness. And it is difficult to plug in the consumer. Finally, given all these constraints, why should an agency head want to participate in PPB?

Mr. Casselman: Program managers, if they're doing their job right, cannot help but plug in the consumers.

Mr. Williams: I disagree with that--he can't. Take health care. A bureaucrat cannot know the whole system. PPB can't tell him.

Mr. Casselman: We're not looking for PPB to tell him all that much--we want him to tell us. And he can understand.

Mr. Bower: It's obvious that program managers know a great deal. But they cannot be expected to grasp the "big picture." Specific problems--traffic on Storrow Drive--are one thing--the transportation problems of metropolitan Boston another. A program manager cannot be expected to understand and/or sympathize with such complex problems as getting people out of the ghetto to suburban jobs.

Mr. Casselman: We can't start at the top--it doesn't work.

Mr. Marden: We need to define the size and shape of the envelope in which we work--but at the same time someone has to be worried about the specific problems.

Is it governmental structure which inhibits action and progress (including in relation to technology) or is it that we don't know the techniques anyhow?

Mr. Duehay: The MBTA doesn't provide a more balanced transportation system because the legislation doesn't provide sufficient borrowing power. Legislators see two things: (1) they suspect what's going on; and (2) they feel more federal dollars should be involved.

We can't wholly rely on middle level bureaucrats --that's only part of the issue.

Mr. Casselman: I'm not saying that. I merely state that the program manager is where you start. You begin to get systematic analysis, done by him.

Mrs. Fasteau: I don't particularly like what's being done to my case. The tough problem is: what should a mayor do about decision-making? Program managers are a tough place to start--they need a lot of training. And they can't analyze in a vacuum. To leave it at lower levels is dodging; it must come from bottom up and top down.

Mr. Casselman Mayors and governors can't understand their budgets nowadays. Decisions should be placed before a chief executive in coherent terms so he knows the trade-offs.

Mr. Berg: The present state of the art indicates that PPB has worked--really worked--only where specific problems have been addressed. And these have taken place at relatively low levels. I haven't really been successful at higher levels yet.

Mr. Duehay: What's the purpose of PPB? We should view it merely as a process which can provide another, hopefully more objective, input to the ultimate political balance the chief executive must face.

Mr. Marden: Our PPB effort is making its way up, and it includes the question of what we want it to do. One benefit is the chance to turn back on the squeaky wheel: "What have you done for us lately?"

We're dissatisfied with many present directions or extent of public expenditure--the moon and certainly Vietnam. But we cannot be said to be certain where redirected resources, if any, should be put. PPB may help here.

Mr. Mettler: I want to ask a question. Are there any legislators here? (No response) Well, I'm one, from Connecticut. I'm also a businessman. Today in this country we operate under a 200-year-old management system, a pretty good one. The politicians propose goals; the people select them by electing politicians. Bureaucracies are set up to implement the legislative goals.

But one sector--the legislature--has almost completely broken down. Decision-making no longer lies there, due to a near-abdication. We must think about this--decision-making should remain there, with those who are responsible to the people. Then we should staff and pay them adequately and make sure they are relevant decision-makers with the tools needed to work.

Mr. Wilson: Why are legislatures so reluctant to vote themselves funds for staff and salary?

Mr. Mettler: Political cowardice, generally.

Mr. Marden: It's good to know what we have available. We have real problems of how to plug it in. I sympathize with legislators. They often need to know as much as us, with fewer resources, and they are judged more often.

Mr. Duehay: Isn't that part of the problem?

Mr. Marden: That may well be. There is, however, no quick payoff. To gain political support and dollars. you have to over-promise or be under the gun of a crisis (which we may well be now).

But back to an earlier question--is there a useful and immediate usage of science and technology in government structure and processes?

Mr. Gostenhofer: One--technological forecasting. The program manager's impact is lacking insofar as he doesn't know what will be available 10 or 15 or 20 years from now.

Mr. Brown: An information gap exists. Studies are done; we rush on to do another. We should try to sell it first. Presentation problems exist when (1) it's an inch thick and/or (2) it's in jargon so thick it's foreign language. Decision-makers can't be expected to wade through.

I question, though, whether there's enough technological (forecast or otherwise) information available to enable a decision not to widen a road, for example, based on new technology which "may" come out in 5 years.

Mr. Marden: Is personnel a problem?

Mr. Bower: It certainly is.

Section C: Solid Waste Disposal

"Municipal Solid Waste and Urban Air Pollution"--Walter R. Niessen, Arthur D. Little, Inc., Cambridge, Massachusetts

Introduction

American municipalities are facing a glut of solid wastes. While nearly all communities in all parts of the country are affected by the solid waste disposal problem, the larger urban centers are particularly troubled because of their high population densities and consequent high rates of solid waste generation. In large metropolitan areas, where sites for land-fill disposal are often unavailable, the growing reliance on incineration for refuse volume reduction and sterilization has been responsible for increasing amounts of air pollution from this source. Incineration-caused air pollution, of which particulate matter is generally considered the most offensive, can contribute as much as 20 percent of the particulate air pollution in our major cities; on a nationwide basis, it represents less than 5 percent of all pollutants.

From these observations, it is clear why the federal government and city administrations are increasingly concerned about air pollution from solid waste incineration and about the mounting volumes of municipal refuse we expect to dispose of in this manner in our larger cities.

If the municipal solid waste glut is a growing concern to us in 1970, our projected quantities and types of collected municipal refuse for the years ahead offer no comfort. Within 10 years, U. S.

municipalities will have twice the volumes of solid wastes to contend with (compared with 1968 levels); by the end of the century, they will have four times the present disposal problem, if we assume a continuation of our "throw-away" life style.

Scope of the Municipal Refuse Problem

Americans produce literally mountains of solid waste. Of the eleven basic categories of solid waste surveyed by the Bureau of Solid Waste Management of HEW, only the first two, household and commercial refuse, are generally collected by municipalities for disposal.

Americans generate household and commercial wastes at an average rate of 6.2 pounds per person per day, totaling 620,000 tons each day or 225 million tons per year. Of this, more than 115 million tons is generated in our larger urban areas, as defined by the State Economic areas, a Census Bureau statistical series.[1] Of this six pounds plus of refuse generated per person per day, only 69 percent of it is currently collected by municipalities. In the Northeastern states, the portion collected averages a bit higher, approximately 75 percent.

Local communities handle their refuse problems in a variety of ways. Historically, areas of population concentration have turned either to land-fill or to incineration to dispose of their solid wastes. Although few land-fill operations are carried out in a truly sanitary fashion, land-fill offers the attractive features of minimum capital investment and operating cost. With advancing years, however, metropolitan centers have saturated the available close-in fill sites and many are faced with an impending disposal crisis within the next two to five years. These pressures have led many jurisdictions to look for land-fill sites beyond their political boundaries in less densely populated, but more distant, areas.

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[1] If we considered other major sources of solid waste, such as agricultural production, mining and industrial waste, the total solid waste volume in the U. S. may be five to ten times greater--from 1 to 2.2 billion tons per year.

This need has led to the postulation of a number of transfer and long haul concepts, the most visible of which is the rail-haul of baled refuse to remote land-fill sites. In many cases, jurisdictional battles, political naïveté, zoning regulations, and strong public reactions have blocked these efforts. Many municipalities are confronted with the possibility that they must cope with their solid waste problem entirely within their present political boundaries. Recognizing this possibility, the eyes of increasing numbers of communities have shifted to incineration.

Through a detailed analysis of available data, a representative, "average" refuse composition for the U. S. on an "as-discarded" basis has been derived. ("As-discarded" refers to the nature of the waste as it is thrown away by residents. Obviously, there are some changes that occur with time including such things as moisture transfer from soggy garbage to paper products, etc.) Table 1 shows the relative proportions of materials in this representative municipal refuse.

Table 1

Annual Average Refuse Composition--As-Discarded Basis

Category	Wt. %	Description
Glass	8.3%	Bottles (primarily)
Metal	8.2	Cans, Wire, Foil
Paper	35.6	Various Types, some with fillers
Plastics	1.1	Polyvinyl Chloride, Polyethylene, Styrene Found in Packaging, Housewares, Furniture, Toys and Non-Woven Synthetics
Leather & Rubber	1.5	Shoes, Tires, Toys
Textiles	1.9	Cellulosic, Protein, & Woven Synthetics
Wood	2.5	Wooden Packaging, Furniture, Logs, Twigs
Food Wastes	23.7	Garbage
Miscellaneous	1.7	Inorganic Ash, Stones, Dust
Yard Wastes	15.5	Grass, Brush, Shrub Trimmings, Some Soil
	100.0%	

Projected Growth in Refuse Volume

Our present refuse problems are already serious. An examination of projected growth in collected waste volumes and composition changes offers no relief to municipal governments already hard pressed by high money costs and foundering in a sea of uncertainty over solid waste problems, among others.

It is generally agreed that the per capita rate of refuse generation is increasing about 2 percent a year. Compounded with population growth, this means that the U. S. will be generating over two and a half times its present volume of municipal refuse by the year 2000 or some 550 million tons per year.

Based on our analysis, the 1968 refuse disposal burden placed on the urban cities, as indicated by the State Economic areas of the

U. S. Census Bureau, approximates 80 million tons per year of the 157 million tons collected nationwide (69 percent of 225 million tons generated). Compounding in the future by the effects of increasing population and waste generation and expanded collection practices, this waste disposal burden is projected to increase to over 140 million tons by 1980 and to over 270 million tons per year by the year 2000. Clearly, the waste disposal crisis now facing our cities will intensify in forthcoming years.

An important factor in these significantly greater volumes of municipal waste to be dealt with in the years ahead will be proportion collected. Communities clearly are moving against inadequate on-site incineration and haphazard dumping, and we anticipate a steady growth in the proportion of refuse collected by and disposed by government. Collected refuse should reach approximately 95 percent of all municipal refuse generated by the year 2000.

The refuse compositions of several quite different general climate regions were forecasted through the year 2000 (Table 2). These estimates are useful in showing trends in various parameters affecting solid waste load and incinerator performance.

The results of our analysis show several significant changes in the nature of refuse over the next thirty years. The effects vary in magnitude but few will make the task of the incinerator operator easier.

For example:

Glass--The projections show that the fraction of glass in refuse will not change significantly over the next thirty years.

TABLE 2

PROJECTED REFUSE COMPOSITIONS (%)*

Refuse Category	1970 Seasonal	1970 Non Seasonal	1975 Seasonal	1975 Non Seasonal	1980 Seasonal	1980 Non Seasonal	2000 Seasonal	2000 Non Seasonal
Glass	9.1	7.9	9.9	8.7	10.3	9.0	8.1	7.2
Metal	8.8	7.6	9.0	7.8	9.3	8.1	7.4	6.5
Paper	39.1	33.5	40.8	35.2	41.5	36.1	49.7	43.5
Plastics	1.3	1.1	1.9	1.7	2.8	2.5	4.2	3.8
Leather & Rubber	1.5	1.3	1.5	1.3	1.5	1.3	1.6	1.4
Textiles	2.0	1.8	2.1	1.9	2.1	1.9	2.8	2.5
Wood	2.5	2.2	2.2	1.9	2.0	1.7	1.3	1.2
Food Wastes	20.2	17.4	17.9	15.5	16.2	14.1	12.1	10.7
Miscellaneous	1.7	1.5	1.5	1.3	1.4	1.2	1.0	0.9
Yard Wastes	13.8	25.7	13.2	24.7	12.9	24.1	11.8	22.3
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Seasonal State - e.g., Massachusetts
Non-Seasonal State - e.g., Florida

*Annual average composition - weight percentages based on moisture content of refuse materials at time of disposal.

This projection could change greatly (downward), however, if low cost beverage and food grade plastic containers are developed. The impact would be still greater if degradeable plastic containers are developed.

Metal--The projections show a slight drop in the metal content of refuse, although on a total weight-discarded basis (considering the growth in per capita rate and population), the amounts may increase slightly in a given community. The economics of metal recovery operations, therefore, should not be expected to vary as a result of changes in the amount of metal present.

Paper--Continuing its historical upward trend, paper, cardboard, and other wood-fiber products will comprise the dominant fraction of refuse. This growth (30-35 percent by 2000) will decrease refuse bulk density, adversely affecting almost all refuse collection, storage and handling operations associated with refuse disposal facilities. The increase may have a favorable impact on the economics of waste paper recovery. This practice should become of increasing importance in light of the diminishing availability of new pulp resources forecast for the late 1980's.

Plastics--The almost 400 percent growth expected in the plastics fraction of refuse indicated that operating problems and the pollution potential associated with the burning of plastics will most likely increase.

Solid Waste Incineration--Effects on Air Pollution

Incineration is increasingly viewed by our major urban areas as a promising disposal method, even though it can contribute as much as 20 percent of the particulate matter now found in the air over our metropolitan cities. Although from a cost standpoint, conventional incineration may not appear to be the preferred means of refuse disposal, it is clear that additional incinerator capacity, in balance with other new and powerful waste disposal and waste recovery concepts, will be required to meet the solid waste problem.

Incinerators represent a relatively minor source of air pollution compared with that produced by power generation, the chemical and metallurgical process industries and transportation vehicles. But with the significant growth anticipated in incineration capacity and in proportion of municipal refuse incinerated (up from 20 percent in cities in 1968 or 90,000 tons/24 hr. day active capacity to 27 percent by 2000 or 31,000 tons/24 hr. day capacity), we will be faced with significant, new additions to the pollution load of the air over our cities, unless we act to prevent it.

Seven pollutants are considered significant from incinerator stacks. They include:

Mineral particulate
Combustible particulate
Carbon monoxide
Sulfur dioxide
Nitrogen oxides
Hydrogen chloride
Hydrocarbons

Although all of these are of some concern, it is the first two categories, the combustible and mineral particulate matter, that cause the most concern and are the target of air pollution abatement activities. Table 3 indicates the estimated amounts of each of these pollutants being produced by incinerators in 1968 and forecast for the year 2000, based on likely patterns of new incineration construction and usage of air pollution controls.

Table 3

Estimated Incinerator Emissions--Seven Major Pollutants*
(Rounded off)

Pollutant	Stock Emissions (Thousands of tons/year)** 1968	2000
Carbon Monoxide	281	829
Mineral Particulate	56	118
Hydrocarbons	22	64
Sulfur Dioxide	32	160
Combustible Particulate	32	49
Nitrogen Oxides	22	114
Hydrogen Chloride	6	147
TOTAL	451	1481

*Two others of small consequence not listed are volatile metals (such as lead) and polynuclear hydrocarbons.

**Stack emissions are those pollutants actually flowing out of the incinerator stack into the atmosphere.

The air pollution control systems for reducing particulate matter in the effluent of existing units vary from literally none to high efficiency electrostatic precipitators and high energy scrubbers. However, because of a lack of organized public concern and definitive state and federal air pollution codes, high performance air pollution control equipment has not been widely installed to curb the emission of particulate matter.

Carbon monoxide is obviously also a major component of incinerator stack effluents, but little action is directed against it because no codes recognized it as a major problem, nor do federal guidelines concern themselves with controls in amounts emitted.

Accordingly, little or no attention has been given to air pollution control devices suitable for removal of carbon monoxide or of other gaseous pollutants, such as hydrogen chloride, sulfur dioxide, nitrogen oxides and hydrocarbons. In general, however, refuse composition and incinerator operating conditions do not yield now significant amounts of these pollutants. A look at the estimated jump in emissions of hydrogen chloride (hydrochloric acid when in contact with water) indicates a potential pollution problem of high order. In 1968, approximately one pound of hydrogen chloride was emitted from incinerator stacks for each ton of refuse burned. By 1980, that level will rise to 2.7 pounds and it will approach 5.5 pounds per ton of refuse by 2000.

The likely trends in particulate pollutant emissions at three possible levels of control in the future are that:

1. Fifty-two percent control is the level attained, on the average, in new incinerators built since the mid-1960's. An extension of this control level will result in more than double the

current load of particulate emissions by 1985 and a five-fold increase within 30 years.

2. A 70 percent air pollution control system requirement for all plants built in the future would result in a slightly slower rate of buildup in particulate emissions during the coming years but will still result in a three-fold increase in emissions by 2000.

3. With 90 percent efficiency in air pollution control in new incinerators built in the future, particulate emissions can be essentially maintained at present levels, despite the anticipated significant increases in incineration capacity. In fact, with 90 percent efficient air pollution control systems on all future incinerators, the present level of particulate emissions can be maintained even though we may have up to four times as many incinerators operating in the U. S. by the end of the century.

The technology and equipment are now available to greatly reduce the air pollution from existing plants. This technology combines the improvement of combustion performance to reduce the combustible portion of air pollutants, and efficient air pollution control systems to assure adequate removal of mineral particulate and acidic pollutant gases.

Regarding technological improvements in incineration, and air pollution control systems, a number of new concepts are at a development stage where full scale demonstration plants are technically justifiable. A spectrum of more advanced concepts has also been advanced. Municipalities, state governments, and the federal government each has its respective role to play in encouraging and sponsoring the development and evaluation of these concepts. Municipalities need to face their solid waste and incineration problem squarely and to help educate their residents to the needs for and benefits of improved facilities, operating practices, personnel and supervision.

State and federal agencies can sponsor demonstration projects and foster regional cooperation by communities to achieve economies of scale.

Improved Incineration--Local Response Is the Key

Solid waste problems are primarily local community problems. As such, they are largely dependent on local conditions, needs and desires.

One factor working in favor of tighter regulations and improved incineration performance standards is the concern of an increasing number of people compared with the apathy that dominated our thinking on this subject in the past.

An important cause of the historically unfavorable performance of incineration units is the posture of the public (as reflected by their municipal governments), with respect to solid waste disposal facilities. Except during brief periods when certain commodities were in limited supply, the American public has considered garbage (solid waste) only as a nuisance. As a result, disposal facilities were built with limited funds and maintained with paltry budgets. Wage scales for workers in this field are often unreasonably low and employment qualifications are seldom matched to the technical requirements of operator assignments. The combination of inadequate air and water pollution controls, unworkable designs, poor maintenance budgets, and public apathy regarding a facility performance has given incineration a distasteful aspect, an aspect which, unfortunately, perpetuates the poor practices of the past. It may be that we are now ready to change this picture.

Section C: Solid Waste Disposal

"Solids Wastes Dispcsal Case Studies"--Frank L. Heaney, Associate, Camp, Dresser, & McKee, Consulting Engineers, Boston, Massachusetts

Case History of Farmington, Connecticut, Regional Wastes Disposal Project

We believe that it is well-known to you that the problems we face do not lack for technological solutions. The lack is in public administration, coordination and implementation of programs. This requires a high degree of cooperation between many disciplines--politicians, public administrators, city engineers and planners, civic groups and last but not least, the voters. Public awareness of the problem is lacking in many localities even when the need is acute.

We were selected by a group of five towns in the Farmington River Valley of Connecticut as their consulting engineers to develop a solid wastes program under the auspices, it was hoped, of the U. S. Public Health Service (USPHS). A project was developed and we were subsequently retained.

Before getting into the case history of this project we would like to illustrate the reasons why USPHS was willing to underwrite a two-year demonstration project study for this area.

This group of towns included Farmington, Avon, Canton, Simsbury and Plainville. Most of these communities are located just west of Hartford and none is a core city. They are five large Connecticut towns which share a common problem of solid wastes disposal.

The basis for obtaining a federal grant for the demonstration program was to develop a unique solution to the problem which could be used by many other groupings of communities throughout the country in the same need. We established in our discussions with the USPHS that the technological problem consisted of identifying the needs and urgencies, cataloging the resources of the area for disposal sites, evaluating the various methods of disposal that could be used and lastly establishing the costs connected with the solution. We would also recommend the most appropriate way of obtaining funds for meeting the cost thereof. We pointed out that here was a wonderful opportunity for these well-administered Connecticut municipalities to pool together the capabilities of their town managers, town planners, town engineers, educational staffs and many interested civic groups to demonstrate a means not only of educating the public in the various aspects of the problem but also to secure the involvement of the various forces which are needed to accomplish a solution to the problem.

If a public health official were asked to name a regional solid waste disposal district in a successful operation he would be hard put to do so. Many have been planned but practically none have been put into operation. The reason, in our opinion, has been the lack of a multiple disciplined approach to the problem. Public awareness of the problem, public involvement and education and most importantly creating a willingness on the part of the electorate to accept and vote the necessary funding just have not been achieved in most cases.

We have recommended strongly the regional concept, including the sharing of site resources for sanitary land-fill or the use of regional incinerators. We have listed the various substantial savings in costs due to the efficiencies of larger operations. It has been most difficult to secure the agreement of a municipality when its site used for sanitary land-fill would last only half as long as when it was used by the town alone.

A study was made of the metropolitan Boston area about 1952 and funds were appropriated by the legislature for regional incinerators. At that time no one could agree in whose town or city a regional incinerator should be located. Except for this stumbling block, everybody thought it would be a wonderful idea. The dismal fact is that the money was not expended and reverted by statute to the General Fund after being unused after seven years with no takers.

Here, then, was the nub of the problem. Why can't communities join in a regional effort to solve a most pressing problem? If the technological means are at hand, economic facts support the concept and the need is critical. The USPHS readily agreed to support such a demonstration project in the aforementioned group of Connecticut communities. The funds for our services were paid out of the $37,250 federal grant. The communities' contribution of one-third of the project cost of $59,200 consisted of the services of their executives and staff for time charged to the program and for expenses for topographical surveys, soils investigations and the like. It was a two-year program. This has now been completed and the federal government is considering issuing the report as part of the demonstration project series of publications. It should furnish a helpful guide to groups of communities throughout the country.

We had been through a dozen regional efforts before this time. We learned a great deal more from this study than we had from the previous engagements. One case in point: at an early public meeting we were told to stop putting so much emphasis on the comparative costs of the various solutions but spend a little more time and effort on doing it the nicer way. This, we thought we were doing, but we had it brought home to us with considerable emphasis that the purpose of all of this effort is really to improve our way of living. We all seek to better our environment to provide a clean and well ordered way of handling our wastes. Backyard burning, or worse, indiscriminate dumping, is a way of the past. We have had enough of neglect of the waste disposal problem. This is basic, to be sure, but how often it is overlooked.

The environment, the towns and cities in which we live, the countryside, all of this is now changing with a breathtaking rapidity. A disposal area for solid waste now has to be a facility that we would accept in our urban system. It has to be a good neighbor. It no longer can be a rat and roach infested dump or so-called modified land-fill. Least of all will we tolerate burning dumps which leave their lingering smells and haze about the towns for days on end.

So much for the spade work. As engineers, we know you expect us to furnish our conception of the parameters of the problem as developed in the case study. These are as follows:

1. Efforts must continue to be exerted against the packaging industry to have them give consideration to the ultimate disposal of their products. The crime of non-returnable bottles, for example, should cease to be perpetrated. We currently have an increase in solid wastes of 2 percent per annum per capita due principally to the amounts of wrapping and packaging of our commodities.

2. Aid and direction should be given to the housewife in the handling and storage of waste products within the household. This is needed in single-family home communities, but is especially critical in our burgeoning apartment house developments. In the Farmington Valley study this took the form of proposed rules and regulations to be adopted in the district. This was divided into five categories: industrial, commercial, institutional, apartment and detached dwelling areas. There is, obviously, a wide difference in their requirements.

3. Storage of solid wastes between collections inside the dwelling units needs a great improvement. The use of chutes within the building, particularly in new construction, would help matters considerably. Worst of all, domestic incinerators have provided their neighborhood with noxious odors, black smoke and the fallout of soot and fly ash. A noteworthy development for substitution of incineration is the stands which hold a plastic bag in which the rubbish is compacted and bound at the bottom of a refuse chute.

A more spectacular development is the underground system of vacuum piping which handles the solid waste effluent from an apartment house community to a central disposal point. This has been used in Sweden and is about to be introduced in the United States.

4. The location of the refuse containers on the day which they are to be collected is also of prime concern. The most efficient manner at present is to put these at curbside so they are readily available to collection crews. Efficient, yes, but often very unsightly. In a suburban community of detached homes a better way is to have properly designed storage space within thirty feet of the street line.

It is interesting to note that apartment house complexes often give little thought to the storage of solid wastes. Steel containers holding 2 to 4 cubic yards, located in the parking area, seems to be the latest development. This is a great improvement from the former array of rubbish barrels or the dingy metal barrel storage bins. Sealed systems with chutes connected to packing equipment is a much more acceptable method.

5. Some of the greatest improvements in solid waste disposal methodology can be made in the collection field. The modern packer trucks are efficient but very noisy. In Europe, for many years, they have used a packer truck which breaks up boxes and large articles and continues the grinding process as it collects. This is beginning to find acceptance in this country. Most importantly, the truck operates so quietly that it may be operated at night in traffic congested

areas. Those who have been awakened, while at New York hotels, by the clatter and groan of refuse collection equipment can appreciate this. The cost of collection in most cases is more than the cost of disposal. Use of traffic studies, route analysis and definition of waste collection districts are now made much easier by the use of computer techniques. Cost savings can be very substantial.

What, then, you may ask, had utopia been reached? No, there was one thorny question unanswered. Farmington unquestionably had the best regional sanitary land-fill within its borders. It would cost every community, including Farmington, less to share in a common sanitary land-fill. The people accepted the fact that the operation would be conducted without nuisance. They were well aware also that a large area gutted by extensive gravel borrow operation would be converted into a beautiful well planned park.

The people in Farmington did not like the idea that their neighboring towns would be disposing of their refuse in Farmington. In addition, what overriding incentive is there to use up their resources for waste disposal in 17 years when, if used for their own exclusive use, they would last for 40 years? Cost savings, even though substantial, may not overcome these reservations. It is too early to tell.

This, then, is the outline of the universal problem. Will it take federal or state interventions to accomplish the needed cooperation? We would hope that the increasing willingness of communities to join together in planning districts is an indication that they also will join together for waste disposal districts.

Section C: Solid Waste Disposal

Chairman: John F. Collins, Sloan School of Management, Massachusetts Institute of Technology

Professor John F. Collins stressed "the importance of the management of solid waste programs, the impact of new technologies upon the overall environment, and the importance of minimizing waste generation and re-using what is generated," and also suggested the use of "systems analysis and operational research" in dealing with management, the environment, and re-use."

Frank L. Heaney (Camp, Dresser, and McKee, Inc.) observed that a discrepancy exists between what people want (e.g., on time collection of their rubbish) and their concern for such things as environmental factors. People are normally unaware of the nuisance caused by solid wastes unless they live near an incinerator, dump or landfill site. They are also unaware of the difficulty in restoring such things as water supplies once they are polluted by careless solid waste disposal practices.

The problem he suggested is finding ways to involve local active groups (e.g., League of Women Voters) in solid waste disposal problems. The difficulty in doing this results from the lack of a clear and obvious crisis and from the unwillingness of people to make sacrifices. More effective means of communicating the long-term consequences of not acting today are called for.

The possibility was raised of having the states mandate regional cooperation. It was recognized that this might lead to a proliferation of special districts, which were held to already be excessive in number. A single regional body, without regard to the type of problem, had an alternative offered to the proliferation of special districts. Different methods of handling wastes were discussed.

John S. Burlew, Director, Connecticut Research Commission, suggested the conversion of solid wastes into useful products. In Connecticut, household rubbish has been converted to (1) a glassy slag, useful as a building material; and (2) a combustible gas by a thermal reaction at the rate of one ton/hour over an operating period of one month.

Benjamin H. Renshaw III (University of Pennsylvania, Philadelphia) expressed his concern for "40 miles from nowhere" and said that county commissioners could accept or reject rail haul dumping. He said Hamilton Fish suggested the use of regional centers involving industrial complexes where (1) waste heat use; (2) reclamation; and (3) recycling could take place. The type of center wouldn't have to be 40 miles from nowhere. Recycling was held to be too distant a solution. More immediate solutions were said to depend upon improved incineration and disposal at sea.

Richard W. Porter (General Electric Company) disagreed with the emphasis on recycling. He pointed out processes to make new paper and food for ruminants from waste paper and to feed bacteria on waste paper. He then asked if the cost of separation didn't seriously affect recycling programs. Indeed recycling seemed to some far less likely a solution to improved incineration because of the higher costs of the former. If necessary, some participants suggested, it would be desirable to tax commodities to underwrite the otherwise unprofitable recycling. Even here, however, several alternative solutions might have to be developed to fit the characteristics of an array of areas.

Methods of improving communications so that citizens would perceive that science and technology could be utilized in public programs were then discussed. It was suggested that people be placed on actual working boards, instead of just letting them work through normal community involvement groups. Action groups channeled directly into the problem areas were one such possibility. Examples of members of the League of Women Voters doing field research, and of Dartmouth students who found in only two days that apartment house incinerators would not solve our pollution problems, were cited.

David F. Bruno (New York Conference of Mayors and Municipal Officials) said that the problem was one of political representation. He said that the municipalities were underrepresented in state legislatures. It was argued, however, that even new coalitions often find themselves in conflict with the inner city after reapportionment.

Section D: Transportation

"Innovation in Center City Transportation--A Case Report"--Herbert S. Levinson, Vice-President, Wilbur Smith and Associates, New Haven, Connecticut

I. THE CENTER CITY TRANSPORTATION PROJECT

Central business districts prosper or decline in relation to the relative efficiency with which they produce economic goods and services. The decentralization of urban activity has brought accompanying changes in the strength, vitality, and function of the central business district; these changes--the decline in retailing and manufacturing and the selective resurgence of office building construction--have been well documented. They have been accompanied by a dispersion of urban travel patterns and a decline in the use and status of public transportation services.

The economic vitality of the center city is essential to the entire urban region; it provides a very significant portion of the over-all tax support for city government, and the focus for many business, service, and governmental activities. Efficient transportation to and within this area has become an important public concern.[1]

The present paper constitutes a case report of the Center City Transportation Project initiated by the Urban Mass Transportation Administration in March, 1969. This multi-disciplined project explores center city transportation in Atlanta, Dallas, Denver, Pittsburgh, and

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[1] The center city includes the central business district and the adjacent functionally related areas.

Seattle.[2] It identifies the economic, environmental, technological, and institutional constraints to improved transportation, and it suggests ways to overcome these constraints and accelerate public transportation improvements. Innovations in public transport services are an integral part of this action-oriented program.

The five cities vary in location, geography, and downtown intensity. Each dominates its metropolitan area, is experiencing center city growth, and is representative of many medium-sized metropolitan areas.

Typical center city transportation problems include: (1) difficult pedestrian circulation between major activity centers; (2) offset and irregular street patterns; (3) lack of regional rapid transit services; (4) limited express highway access; and (5) land fragmentation by parking facilities.[3] These problems will intensify as center city employment growth continues. This growth, in turn, will increase the importance of public transport services, since it is recognized that future peak-hour travel demands in the five center cities cannot be accommodated by automobile alone. (Projected employment for Dallas--nearly 180,000 by 1980--for example, will result in nearly 50,000 additional peak-hour trips; yet, only one corridor remains where additional expressways can be inserted.)

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[2] Participating firms are Arthur D. Little, Inc. (management), Skidmore, Owings, and Merrill (urban design), Real Estate Research Corporation (economics), and Wilbur Smith and Associates (transportation). This paper presents the views of the author, and not necessarily those of the consortium.

[3] See Center City Transportation Project, Phase I Report, November, 1969.

Peak-hour congestion on the gateways to the center city is usually more serious than within the center city itself. This became an important constraining factor in developing center city transport solutions: the project scope limited improvement proposals to the center city; consequently, needed regional "line-haul" highway and public transport improvements in virtually every city were excluded from detailed consideration.

Equally as significant are the fiscal and institutional constraints to center city mobility. In general, public transport improvements have not kept pace with center city growth. Moreover, many existing transit operations are marginal financially; maintaining service and offsetting operating deficits are primary concerns. Concurrently, most planning efforts are focused on long-range regional rapid systems--systems which are often predicated on anticipated future growth of downtown; systems whose extent and coverage sometimes are extended by the need for political support of bond issues or limited by the available funding resources.

Given these constraints, it is only natural that public transport innovation and experimentation have been virtually nonexistent. Yet, such experimentation is needed if long-range breakthroughs are to be achieved in center city mobility. Increased federal emphasis on urban transportation innovation and greater federal funding capabilities are essential.

II. CENTER CITY TRANSPORT TECHNOLOGIES

Technological innovations in urban transportation are necessary to improve center city mobility, and in turn serve as a catalyst toward center city economy and amenity. Accordingly, a broad overview was made of the status, feasibility, and potential applicability of some 130 candidate urban transportation technologies as they relate to center city mobility requirements. Primary emphasis was given to those technologies which could be implemented within a five-year time frame; a screening process systematically eliminated some 80 systems which were technically or economically unfeasible, or which would not serve center city requirements.[4]

Applicable Technologies

Many transportation technologies are currently available for application in the center city and many others should be available within the next five years. Center city transport technologies fall into three broad categories: (1) buses or similar multi-passenger vehicles operating on existing streets; (2) belt-like systems, operating continuously and always available for passengers to board; and (3) train or fixed guideway-vehicles.

Applicable bus technologies include:

1. The standard diesel bus--perhaps modified to reduce the pollutants emitted.

2. The minibus--small 15 to 24 passenger vehicles.

3. The gas turbine bus--currently being developed.

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[4] See Innovation in Center City Transportation Technology, Wilbur Smith and Associates, 1969.

Applicable "continuous" people-mover technologies include:

1. Moving belts which are currently operating in many airports (Speedwalk, Speed Ramp, and Transitread), and escalators. Costs approximately $350-$500 per linear foot.

2. Variable speed systems in operation (WED-way at Disneyland, or in prototype development (Carveyor).

Applicable or potentially applicable "intermittent" technologies include:

1. The Skybus, or related smaller scale Vehicle Distribution System, being installed in the Tampa and Seattle-Tacoma Airport, and operating at South Park, Pittsburgh.

2. The Minirail, in operation at the Montreal, Munich, and Lusanne Expositions.

3. Smaller Scaled Monorail Systems, such as the Jetrail and Monocab. A simplified system is being considered for the new Dallas-Fort Worth regional airport.

4. Personalized dual-rail trainlike systems such as the Dashaveyor, also being considered for the new Dallas-Fort Worth airport.

Center city mobility is far more complex than movements at airports, amusement parks, and fairs. Within the center city, there are major problems of costs, environmental compatibility, and diversity of demands which must be met. At or above-grade construction will reduce installation costs, but could produce serious environmental conflicts. In some cases, it is possible to penetrate to traverse buildings--but only where they have the structural capability or where pedestrian circulation systems can be incorporated into the basic structure, as in new urban developments. The human dimension poses a serious constraint on the minimum cross-sectional requirements of microsystems (people-movers).

A basic challenge, therefore, is how to strategically insert people-movers--utilizing existing and proposed technologies--into the center city.

Selective application of people-movers must be done within the framework established by line-haul transportation facilities. Center city distribution systems should complement, not supplant, line-haul transportation services. Effective interface and the perimeter of the center city with line-haul facilities is essential.

Much has been said about new urban transportation technologies, but there is little, if any, factual data on the engineering and cost characteristics of most proposed systems. Many proposals merely constitute operational modifications of existing technologies. Some involve unduly complicated suspension or propulsion systems; others appear better suited for inter-city than short-haul, readily-available service.

Research and experimentation is needed to improve performance capabilities and environmental qualities of existing and near-term technologies. Research efforts should be directed toward achieving:

1. Buses with less noise and exhaust, and better loading systems. More extensive research on noise reduction and exhaust elimination is essential, particularly where underground operations are involved; gas turbine buses offer some promise in this context.

2. Differential-speed moving belt based systems which can negotiate grades and curves. The continuous-motion character of moving-belt technology is especially suitable for short-distance, high-volume situations.

3. Fixed-guideway systems with reduced cross sections, capital costs, and simplified support, suspension, and switching mechanisms.

III. THE CENTER CITY TRANSPORTATION PROJECTS

Each center city has opportunities to use its topographic and land-use features in a meaningful way to improve its transportation. Each has a number of realistic transport improvement options. Accordingly seventeen center city transportation projects were evaluated in depth; they were selected in cooperation with the city officials after extensive screening of a wide variety of candidate improvements.[5]

The projects reflect city needs and national program requirements. They include both early actions and longer range proposals as part of an evolutionary transportation improvement process. They are designed to improve circulation to and within the center city. They relate to present and future land-use patterns, and incorporate new movement concepts.

Accordingly, the projects reflect (1) commonality and transferability of solutions; (2) innovative and imaginative approaches; (3) potentials for institutional change; (4) focus on center city problems; (5) application of basic planning principles; (6) application of national and local project selection criteria; and (7) relevance to national guidelines and policies.

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[5] See Summary Project Report, Working Draft, November 17, 1969, Center City Transportation Project, Arthur D. Little, Inc.

In this context, the following strategy underlies the projects:

1. Efficient radial or line-haul public transportation services play an important role in bringing people to the center city in attracting present automobile users, and in relieving street congestion. Consequently, regional transportation improvements provide an important framework for center city circulation and distribution systems. Projects are carefully coordinated with the line-haul public transportation systems being developed independently by regional planning groups.

2. Projects are multi-modal. They permit coordination of highway public transport, pedestrian micro-systems, goods movement, and terminal facilities. Street and highway-related improvements are necessary to allow more effective and innovative use of public transportation to facilitate development of pedestrian ways, and to improve traffic flow.

3. Projects reflect auto-diversion and auto-intercept strategies (i.e., the diversion of automobile trips to improved line-haul transit or the interception of automobiles at the edge of the center city). An integrated sequence of intercept projects will test the effectiveness of varying types of center city distribution facilities and locations of off-street parking. They can help identify the significance of such factors on trip costs, trip lines, and passenger comfort. Atlanta's operation intercept systems and Denver's Mile High Stadium bus-parking systems are among these projects.

4. A center city distribution strategy calls for a staged multi-modal systems approach. It includes optimization of street movements through traffic controls and transit routings, provisions of specialized movement channels for each mode (e.g., bus streets, pedestrian malls and ways), and coordination of movement systems with redevelopment projects. The street circulation and bus routing plans in each city, and the internal pedestrian corridors for people-movers in Pittsburgh and Seattle are part of this strategy. The proposed Smithfield-Wood bus lanes in Pittsburgh are especially significant since they will test the feasibility of on-street distribution in the center city for regional bus rapid transit.

5. An evolutionary goods strategy is suggested for Dallas. It includes more effective designation of truck routes, truck and loading periods; traffic operational improvements designed to improve truck movements, such as corner widenings, improved loading docks, etc.; modifications in truck ordinances, particularly with regard to zoning requirements for new developments; and construction of special truck ways and tunnels to remove major truck flows from downtown streets.

IV. PROJECT IMPLEMENTATION

Project implementation is a far more difficult task than project conceptualization. Implementation requires consensus of local business and governmental leaders. It also requires local funding commitments at a time when there are many competing demands for urban resources. Despite this constraint, several projects have been implemented or are in the process of implementation. This is consistent with the Urban Mass Transportation Administration's desires for early action.

Atlanta

"Operation Intercept," Atlanta's new Town Flyer shuttle bus system, was inaugurated in December 1969. This service was sponsored as a joint effort by the city of Atlanta, Atlanta Transit System, and the business community in an attempt to intercept motorists at peripheral parking facilities located adjacent to express highways. The two-mile route connects parking at the Atlanta Stadium and the Civic Center with the Atlanta central business district. Service is provided by the Atlantic Transit System, and federal funds have helped support publicity costs. Fares were established at 50 cents for the auto driver, including parking fee and round trip bus ride, and 15 cents per ride for other passengers. One-way travel time averages 10 to 12 minutes.

During the Christmas holiday period, service operated from 7:00 a.m. to 9:30 p.m. In January, service was limited to peak hours only, with the existing Shoppers Shuttle bus extended to the stadium. Comparative operating statistics for the Town Flyer Service are shown in Table 1.

1. During the period of full operation, nearly 1,900 people rode the Town Flyer bus each day; almost 600 were auto drivers.

2. During the period of contracted operation, about 440 people rode the bus each day; 330 were auto drivers. These figures, however, may underestimate total use of the service, since midday riding to the Atlanta Stadium was absorbed in the normal shopper shuttle service.

Table 1

Average Daily Bus Passenger Trips

Town Flyer

Type Traveler	November 29, 1969, to November 5, 1970 Full Service (5 weeks)		January 5 through February 28, 1970[6] (8 weeks)	
	No.	Percent	No.	Percent
STADIUM				
Automobile Driver	426	22.5	200	45.2
Automobile Passenger	567	30.0	47	10.5
CIVIC CENTER				
Automobile Driver	165	8.7	131	29.7
Automobile Passenger	102	5.3	28	6.3
MID-ROUTE PASSENGER	635	33.5	37	8.3
TOTAL	1,895	100.0	443	100.0
Automobiles Diverted	335		165	

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[6] Excludes midday patrons riding shoppers' shuttle midroute or to stadium.

SOURCE: Wilbur Smith and Associates.

3. The number of automobile drivers using the Civic Center parking lot remained almost constant, despite the curtailment of off-peak service.

4. Approximately 200 cars were removed from downtown Atlanta streets during each peak hour.

Despite inadequate approach road signing and limited public information programs, the bus service has retained its riders. Accordingly, efforts are currently underway to upgrade and expand the service--including better approach road signing, additional routing consolidations, and newer buses. While "Operation Intercept," alone, is no panacea for downtown Atlanta's traffic congestion, in combination with other downtown bus routing and pedestrian way improvements it could lead to improved center city mobility.

The Other Cities

Project implementation in the other four cities is progressing at various rates. Progress usually varies inversely with project cost and complexity. Consequently, implementation of shuttle buses is easier than developing new people-mover systems, which involve unproven technologies or extensive right-of-way acquisition. A capital grant application is being prepared for a truck tunnel in Dallas.

An application for a center city shuttle bus has been submitted in Denver.

Progress is underway in achieving acceptance by Pittsburgh governmental agencies of a multi-stage downtown street and transit routing plan. The plan attempts to develop a system of priority transit lanes in conjunction with possible through routing of express and local buses.

V. PROGRAM AND POLICY IMPLICATIONS

Center city transportation is a small yet key part of the metropolitan transport network. Perhaps more than any other component, it can be influenced by policy and private sector participation. It is in this context that the center city transportation project should be evaluated.

Program Evaluation

The center city transportation project was designed to (1) achieve improvements in downtown mobility, especially by public transport; (2) provide incentives to research and experimentation in new urban transportation systems; (3) stimulate national interest and awareness in center city transport; and (4) help develop the needed constituency for supporting additional federal transit programs. Each of these objectives has been achieved to a varying extent.

The program has achieved national interest and attention. Through a series of seminars, its impacts and concepts have been extended to many other cities. It is conceivable that some of these cities may generate new, innovative center city public transport projects.

Many projects, such as Seattle's up-hill people-mover and Dallas' transportation terminal, are highly innovational. Over-all, however, the nature of the study cities, UMTA's desire for early implementation, and the limitation of projects to within the center city served as constraints. Thus, there are no Grand Central Station or Market Street East projects within the candidate proposals!

In most cities, the major transportation problem is access to the center city. By concentrating on improvements within the downtown, comparatively minimal gains are achieved in line-haul services. Comparatively few projects will actually modify the modal distributions of travel to the center city, or the re-orientation of suburban travelers to the downtown. (Line-haul improvements are being developed under complementary federal programs.)

The project has improved the dialogue between city and federal agencies. Cities are willing to implement projects--to the extent that funds are available and that project implementation does not defer other desired improvements.

The working relationships and balance among various local government (and citizen) groups have been carefully developed in each metropolitan area. Urban priorities in general and urban transportation priorities in specific must remain primarily a local concern. Thus, the project raises an important question: to what extent must center city transportation improvements be generated by and within the city itself (i.e., be endogenous rather than exogenous).

Some Policy Possibilities

Center city transportation brings to focus the many institutional problems characteristic to the nation's urban areas. There is an almost universal need to improve current institutional arrangements.

Federal policies can provide important guidance in this area. Several pertinent observations follow:

1. Transportation improvement objectives and resources are usually diffused among state, regional, and local agencies. Planning functions are too often removed from financing and implementation capabilities. The region is the logical geographic unit for transport planning and operations, but it is usually weakest in terms of finance and implementation capabilities.

2. Transportation implementation, and funding capabilities at all levels of government should be strengthened. There is a need to achieve a more effective balance between planning and implementation. In some cases this may call for state Departments of Transportation to oversee urban transport; in other cases local or regional agencies may be strengthened. For example, in medium-sized, single-centered metropolitan areas, where the city encompasses most of the metropolitan area, consideration could be given to a combined metropolitan public transportation and parking authority.

3. The comprehensive regional land-use and transportation planning process should be broadened in scope; preparation of coordinated rather than separate "highway" and "tansit" plans should be encouraged. A detailed "center city" plan should be incorporated as part of the over-all plans.

4. Street circulation and parking improvements are integral parts of every center city plan. This suggests a broader sponsorship of the future center city transportation programs within the Department of Transportation. Line-haul public transportation services, however, should remain a primary concern of UMTA.

5. There is need to provide comparable local access to various federal transportation programs. Ideally, local decision-making would be improved with comparable local-share (percentage) contributions to each federal program.

6. Research and experimentation in new technologies largely should remain a federal responsibility. This may call for full federal funding of new people-mover systems within center cities as prototype developments.

7. Maintaining existing transit services should mainly rely on local initiative. There are many ways to achieve this objective--for example, a downtown parking tax or surcharge--ways in which center city land users could share in downtown public transport modernization, or a household/employee tax such as recently established in Seattle.

8. The extent to which auto access to the center city should be encouraged or inhibited will depend on city size, downtown intensity, prevailing public attitudes, and a variety of related factors. The study cities and most cities in the United States are not ready for, or willing to accept, pricing constraints to motor vehicle travel. These will probably come about gradually as downtown land-use intensifies, downtown parking rates increase, and additional urban toll roads are constructed.

9. The emergence of metropolitan government (or the metropolitanization of key urban functions) may give rise to a new set of urban (or metropolitan) priorities. Such changes will have major bearing on the future role of the center city.

Section D: Transportation

Chairman: Frank C. Colcord, Chairman, Department of Political Science, Tufts University

Recommendations

1. There is a need for money to be made available to cities to use for transportation systems as they wish.

2. There is a need for meaningful regional goals and strategies.

3. There is a need for new political institutions and federal assistance in this effort.

4. There is a need for meaningful participation by groups in the public in the planning process.

5. There is a need for more R & D money to develop new innovative transportation facilities and services, e.g., the new Cambridge R & D Center.

6. There is a need for the federal government to sponsor long-range R & D.

7. Consideration should be given to slowing the growth of cities.

Mr. Herbert S. Levinson added some observations and recommendations to his presentation on the development of prototype transportation systems for central city use:

1. The most feasible systems for implementation within the next five years involve the use of buses, moving ramps, sky-buses, minibuses, minirails, monorails, and various automobile alternatives.

2. The Central Cities Project has helped in developing local based innovative outlooks towards transportation options, coordinated the thinking of local officials, and helped to develop the needed constituencies that can further lobby for transportation improvements for the central areas. Through a series of seminars, the project has aided in improving the dialogue between local officials and the federal officials. Little impact, however, has been had on the institutional structures. There is much need for changes there.

3. The region seems to be the best scale for transportation planning, yet it is just at this scale that the weakest forms of implementation lie. Regional governments such as at Toronto or in Dade County would help. Coordination and balance in transportation planning are necessary objectives and state departments of transportation should be established to better implement such goals. Better data on regional land use and projection models are needed. Even with improvements in other modes of transport, street circulation and automobile parking require extensive improvements in center city areas. To insure the highest quality and most extensive funding, research and demonstration projects should be administered from the federal level. The maintenance of local transit systems should remain a local financial responsibility. Further general policy questions such as priority of modes or auto access questions should remain local to respond to situational needs.

Mr. Levinson was asked if consideration had been given in his study to (1) the idea of separating users by mode and by time in regard to their various functions; and (2) the total question of why people want to travel at all.

Mr. Levinson replied that separating various transport systems by time and by space would permit more effective use of highway systems. The possibilities of reducing the need to travel involved the whole question of restructuring urban land use.

The point was raised that the session might be addressing the wrong questions. The question is not how to invent new technologies, but rather how to improve transportation with the systems we already have. Experts are needed to implement existing technologies as well as offer new options. Perhaps of late, however, too great a reliance has been placed on public entrepreneurs. Existing transit systems were primarily built through private finances. Private entrepreneurs should be encouraged to experiment around, to build demonstration projects.

The possibility of developing new options was considered "academic." The present system of transportation financing does not permit an implementation of all these options. The present transportation system was built on a user fee basis. No matter what innovation is considered, the user fees are controlled by the automobile mode. A pot of free funds is needed to try out new options. A planner today cannot plan ideally because he can only finance certain modes. Non-categorized funding in large doses is needed for local improvements in just plain urban transportation.

Development of regional rather than situational solutions to transportation problems was advocated.

The basic institutional structures for this change was felt to already exist in some places, for example, at Boston's MBTA or

Chicago's CTA. The issue was seen to be one of empowering these regional agencies to be able to properly operate large multi-modal systems.

Financing of urban transportation systems was analyzed from two perspectives: (1) keeping the present system going; and (2) developing system extensions. The first was seen as a local responsibility. No major transit developments have come from the farebox receipts. Such improvements need other kinds of funding.

Two options were suggested to finance existing systems. First, a flat surcharge to maintain system; might be on property or sales. Second, a pricing system, such as parking taxes, which would hit the worst offenders but really be for only the all-day parker. This would tend to encourage further peak-hour use of the transit facilities.

The discussion returned to the earliest theme of transporting information instead of people. This was held to run counter to the tendencies of people to travel more as their incomes rose. People want to be mobile and they still like face-to-face contact.

Even in cities without a strong tradition of face-to-face communication such as Houston, there is still pressure for a strong downtown where people have to come to meet with each other.

Section E: Housing

"A Corporation's Transition to Industrialized Housing Production--A Case Report"--A. E. Rosfeld, Vice-President, Stirling Homex Corporation

The Stirling Homex Corporation of Avon, New York, in less than two years made a remarkable transition from the conventional construction of housing to the production of modules (fully completed--both exterior and interior--components of housing).

The case report which follows emphasizes those elements outside the plant which determine whether or not industrialized housing production can be effectively utilized.

Identifying A Market

Industrialized housing makes sense only if the producer can continuously turn over his product in return for its reasonable value. If the industrial producer is also required to maintain an equity in its buildings and undertake their management, corporate resources will be continually diminishing.

On the other hand, the decision that such a turnover is necessary is not so very easy to implement. There are not so many investors desirous of purchasing rental property at a price that will afford a fair return to the builder, although there are some who are willing to assume the builder's mortgage so long as it is accompanied by his equity.

Following this approach, it does not take so very long to discover that the best arena for the industrial housing producer is the federally subsidized market. In particular, this market has the following advantages:

1. It permits a complete return to the producer of the fair value of his property by utilizing nonprofits, cooperatives, or local housing authorities.

2. It eliminates much of the burden of showing economic feasibility by supplying a federally guaranteed revenue flow through a debt service subsidy.

3. It provides a management device through the use of nonprofits, cooperatives, and local housing authorities.

4. It presents a pre-aggregated market.

A National Price Structure and Its Impact

A. Establishment of a Price Structure

Once Stirling Homex recognized its own production potential, it became apparent that a nationwide pricing system was both a necessity and an obligation for the following reasons:

1. Clearly, even the least sophisticated purchaser would recognize that all Homex housing costs were constant except for those related to the purchase of land, transportation of modules, and site improvement; therefore, most of the factors affecting cost were out in the open.

2. From all points of view, the most acceptable strategy vis-à-vis the local builder is to take the mystery out of the home building business by establishing one price and clearly identifying

the product being offered--in other words, while not completely analogous, a variation of the Sears Roebuck catalog.

3. High volume sales of housing can only occur when price and quality are stable and well identified items.

4. In return for the public acceptance of industrialized housing, the industry itself would have to return a standardization, if not a reduction, in housing cost.

Stirling Homex developed a price list which included a cost for modules, site improvements, and "other" which includes supervision, field engineering, on-site costs, architectural, planning and engineering, general and overhead, developer profit, etc. Reading the pricing schedule, one can then determine the exact price--excluding only the cost of site acquisition upon which Homex accepts no profit--of a housing unit based upon the number of bedrooms.

An important element of the pricing schedule is that it does utilize cost averaging. Clearly, such elements as site improvements and the transportation cost of modules will vary from state to state and from site to site. Nevertheless, the obvious advantages of an overall pricing structure applicable to any section of the country outweighed whatever particular value there might be in establishing item-by-item costs.

B. Overall Governmental Savings Versus Local Price Criteria

A nationally determined price structure is in the best interest of the government in that the amount of the government's subsidy is based on debt services which, in turn, are a factor of total cost. Nevertheless, it was found that the national pricing structure is severely prejudiced by the importance given to local criteria in negotiating individual contracts. For example:

-- Although a national unit cost limitation is established by statute, in the Section 235 and 236 Homeownership and Rental Assistance programs, the actual limitation is a factor of the income limits established for each locality based upon the limits for public housing and the Section 221(d)(3) Below Market Interest Rate program. For that reason, the effective unit cost limits for these two important programs for moderate income families vary considerably from one locality to another. This has the effect of making it difficult for a national industrialized housing producer to provide his product in many of the lower cost areas of the country (particularly the Southeast and Southwest) and largely restricts him to the major metropolitan areas.

-- The government applies local cost indexes in a number of its programs such as public housing and college housing which, while intending to be fair, take only local conditions--but not necessarily quality of product--into consideration. The college housing program established cost factors in December 1969 which varied from 77 percent in Spartanburg, South Carolina, to 111 percent in Albany, New York, and 121 percent in New York City.

-- Administration of the program by local HUD offices builds into the system subjective standards of cost which are strongly affected by local rather than national considerations.

-- Although the total debt service in the public housing program is paid by the government, local housing authorities have been known to consider a price--deemed acceptable to HUD--as being too high for local consideration.

-- Price comparisons themselves put a known industrialized product (capable of actual appraisal) against an idealized version of what may spring forth from preliminary plans and rough specifications.

-- Statutory provisions with respect to public housing, e.g., Section 235 and Section 236, which establish higher cost limits for so-called "high cost areas," operate against a national price structure.

-- In price negotiations, a nonindustrialized producer is always able to reduce his price through an overt or covert reduction of the quality of his product.

A multiple price structure--while possibly applicable for local builders--is self-defeating when directed at industrialized housing.

Today, it is perfectly possible for a corporation like Stirling Homex to operate profitably on the basis of the current market and cost limitations. However, if the government is ever to secure for itself a true "breakthrough" towards industrialized production of housing, it will have to make it possible for such producers to market their products in all sections of the country, achieve the economies of scale, and return such saving in standardized prices within the reach of the subsidized as well as unsubsidized markets.

Contracting With HUD-Assisted Agencies

One of the first changes in attitude that comes over an industrial producer of housing is a certain impatience with the established procedures.

It soon became apparent that Homex--having established a production facility--simply could not accumulate inventory while awaiting the approval of a contract with HUD. A production facility by definition must be continually producing. Housing modules so manufactured come out of the plant and must be put somewhere. The cost so incurred in the capitalization of the plant, the payroll, and the materials cannot await movement of applications and forms.

Even the presumably non-bureaucratic turnkey program is known to take anywhere from 9 to 22 months from the initial application for a program to the execution of a contract of sale between the housing authority and the developer. Thus, even if Homex were to have made proposals for 40,000 units around the country, it would have had no place for its products and no income for at least nine months.

This lapse in time between making a proposal and receiving payment for the product has been built into the building industry for years. It is part of the pattern and was always acceptable to builders because of the promise of a large return at that future date which would compensate for the two-year loss of income.

It is the hope of Homex that the government will adopt a new contracting procedure designed for industrialized housing which will be based on concepts similar to the following:

-- A single contracting authority would represent as an agent, or under its own powers, varied housing demands of a market area including housing authorities, nonprofits, cooperatives, the unsubsidized market, and all others.

-- The contract would be awarded in response to an advertised solicitation for proposals to build in increments of 1,000 units over a multi-year period for the market area on the basis of a specified type and size of units and in accordance with express criteria broad enough to include all quality industrialized producers while still maintaining a high overall standard of quality.

-- The contract would provide for delivery of the modules and payment therefore at the plant--a requirement that would give housing manufacturers the same benefits currently afforded the traditional builders through the practice of making payments upon the completion of each major phase in the construction process.

-- The contracting authority in return would receive warranties with respect to the modules so delivered.

-- Site improvements and installation of the modules would normally be performed under parallel or consolidated agreements with the module's supplier or its subcontractor subject to guarantees and undertakings as to performance.

Method of Selecting Proposals

Existing methods of soliciting proposals in the subsidized market are also biased against industrialized housing. In addition to the little used acquisition approach, which places the entire risk on the builder, there are two recognized approaches for sale of dwellings to housing authorities:

1. The classic method of selecting proposals through advertised competitive bids is initiated by a preliminary drafting of precise working drawings and specifications by an architect employed by the soliciting authority. Although an industrialized producer is capable of meeting general standards of purpose and quality, a production system is not susceptible to adaptation of its system in all respects so as to correspond to all the details of drawings and specifications. It would only be coincidental if an industrialized producer could respond to a competitive bidding situation. This is particularly unfortunate since the variations between what is sought by the advertised bids and what the industrialized producer can provide would not constitute any substantial variation. Moreover, because of the priorities employed in approving change orders after the start of construction, the ultimate product of the successful competitive bidder often varies substantially from his own proposal.

2. The turnkey method was developed by HUD to avoid many of the evils that had developed in the competitive bidding method which were considered to have added both cost and time to the production of public housing. While the turnkey approach overcame some problems for the industrialized builder, it raised new obstacles, such as the following:

a. Turnkey favors local interests in that a proposal must be based on a site owned and controlled by the developer, and a local individual is obviously more able to identify and obtain acceptable sites than a distant corporation.

b. While appearing to eliminate red tape, turnkey has also eliminated the objective standards which existed in the competitive bidding method; thus, proposals are judged against one another without a full understanding of the quality to be offered. This obviously does not favor a producer with an established quality standard.

c. The fact that merits of a particular site are considered at the same time as the quality of the proposed structure has often forced HUD to accept a less desirable house in order to obtain the only, or one of the few, good sites in the community.

d. The lack of objective criteria in judging proposals has also provided a rationale for housing authorities to choose local builders over others.

e. Turnkey has also encouraged packagers and other types of middlemen who make proposals on the basis of a site without even knowing who will ultimately construct if they are selected. This, in turn, has been responsible for the failure of many approved turnkey projects to proceed to construction.

f. The price negotiation in turnkey is based upon two independent cost estimates prepared on the basis of the developer's working drawings and specifications. Such cost estimates will take into consideration local cost factors and will assume a minimum quality standard. Thus, such estimates have the tendency to over-state the quality of a small local builder's product while understating that of an industrialized quality producer.

Local Considerations

Many local factors work against the creation of a favorable climate for industrialized housing. Among those are the following:

1. The lack of any single housing aggregator to identify and bring together the housing demands of the community. This applies in particular to the middle-income market.

2. The tendency of communities to view housing programs in terms of multiples of 50 fails to establish a sufficient market at any one time which will permit the possible scale economies.

3. The understandable desire of local officials to contract with local businesses under the assumption that there will be an overall financial benefit to the community at large as well as some generating of good will. This kind of thinking overlooks the fact that industrialized producers do hire locally and that the ability of such producers to provide housing on a large scale will have a more dramatic impact on economy than the short-term effect of a few local lumber purchasers and some seasonal employment of construction workers.

4. There still is some residual association between industrialized housing and the manufacture of trailers and "pre-fabs." The horror stories that began some years ago and still reappear occasionally have caused the public to associate manufactured housing with poor quality housing.

5. A corollary of the foregoing is the assumption that manufactured housing should be significantly less costly than the product of a local builder. This belief often causes communities to consider industrialized housing as being overpriced when its price is the same as that which is locally provided. Moreover, the value of speed is often underestimated by communities even though the rapid delivery of housing substantially reduces local administrative costs and has a positive political impact.

On the positive side, Homex has not been troubled by the hobgoblins of the conventional wisdom: codes and unions. The Homex technology can be adapted to meet code requirements and this has been done each time we entered a new state or city. Regarding unions, Homex was the first industrialized housing firm to develop an effective national agreement with the Carpenters Union, which, incidentally, is supported by a training agreement to bring unskilled workers into the Brotherhood.

Difficulties of Market Aggregation

Although the "demand" for housing may be large, this demand is not readily identifiable. There is no agent through which one can proceed to negotiate with it.

Within the market area of sufficient size to invite a housing producer, there are various competing sources which act against a unification of the demand; for example:

1. The numbers and variety of those representing the housing market; that is, realtors, housing authorities, redevelopment authorities, local governments, banks, untold numbers of individuals, land owners, packagers, nonprofits, housing development corporations, etc.

2. The lack of common cause between counties and cities, towns and cities, suburbs and cities, councilmen within a city, the state and the cities, the city councils and the mayors, etc.

3. The fact that an aggregated market is too large for local business to construct for or to finance.

4. The presumed effect of an aggregated market on local control over housing patterns.

5. Although there are innumerable agencies (public, private, and nonprofit) to provide housing for moderate and low-income families, there is no agency established to represent the unsubsidized

market which, today, is unable to find housing on the market, to afford it if it exists, or to encourage new producers to come within the communities.

6. While the Breakthrough Program is providing incentives to states in the establishment of offices to aggregate the market, the fact is that state governments are notoriously understaffed and, in any event, lack the authority and the information sources required to undertake such a program. Moreover, action by the state tends to exclude the major urban centers even when the governors and the mayors are under the same political faith.

7. State boundaries themselves are no longer adequate indicators of market areas. There are few major market areas today which fall neatly within the boundaries of one state. For that reason, it must ultimately fall to an extra-state body to carry out such a role.

8. While encouraging the aggregation of markets, HUD has overlooked its own programming role, which tends to discourage applications for large numbers of units and which reduces the number sought to figures which usually fall short of sustaining an industrialized effort in a community. HUD must rely more on its own broad studies of regional housing needs, and cease its reliance on mechanical techniques such as local application lists for housing, which lose their reliability when long delays cause the community to give up hope for new housing.

The Search for Sites and the Need for Comprehensive Planning

For years it has been a prerequisite to HUD programs that there be comprehensive planning by local governments requesting federal assistance. Nevertheless, cities, counties, and states are still unable to identify where all housing that they request can be situated. Urban renewal programs might have been helpful in that a housing component was a required element, but such programs were more often well funded planning and replanning exercises than opportunities for residential construction and growth.

The result is one of considerable frustration to those capable of rapid high-volume housing production. It is possible to go into a city with a documented need for 5,000 houses and be told that there are no sites even though the city has been a recipient for years of funding to develop plans for residental areas. Thus, it becomes incumbent upon one engaged in the manufacture of housing to also undertake to seek out land for residential construction. Strangely enough, such sites when uncovered seem to have been unknown to the local governments.

Of course, the theoretical ultimate has been the establishment of a so-called land bank which can make its resources available at a pace consistent with the capacity of the industrialized producer and the demands of the housing market. However, a land bank is itself only one of a number of possible tools, and is not a prerequisite. In the end, it is the determination of a local or regional government to take the steps necessary to identify where housing is needed and to see that the land within such areas is cleared of substandard and deteriorating structures, or that incompatible uses are removed.

Section E: Housing

Chairman: John Eberhardt, Dean, School of Architecture and Design,
State University of New York at Buffalo

Recommendations

1. A National Urban Growth Policy precede, or at least accompany, a national housing program. Such a policy must guide the physical placement, population size, social composition and phasing of that housing program.

2. A specific policy be established regarding reform of land and development administration in the older, "built-up" urban areas.

3. Specific measures be taken to improve the maintenance of the nation's existing housing inventory.

4. One national and several regional resource planning agencies be established to monitor and direct the utilization and conservation of all national resources, including land. These agencies are to be executive entities.

5. A policy of anticipatory land acquisition to secure adequate sites for new housing and to assure orderly urban development be formulated.

6. Uniform state-wide building codes, incorporating performance standards and training programs for local officials, be formulated.

Chairman John T. Eberhardt keynoted the section by emphasizing a distinction between housing and houses. Reference must necessarily widen beyond the physical production of houses to encompass the satisfaction of user needs that extend beyond minimal physical safety and comfort. Another spur to a wider reference--to housing--is the knowledge that housing is a constituent of a larger social and economic system. Similarly, the housing production processes have systematic properties themselves. The significance of this housing-as-a-system view is that change at one point in the system has ramifications throughout that system. The locus of change is not "out there" among some actors (here reference was made to the three most frequently alleged sources of resistance to reform of residential construction--obsolete codes, tradition-bound unions and restrictive zoning) but among us. This is the nature of systems and of systematic change: no single element points the accusing finger, casts the first stone and remains unchanged itself.

The "Case Report" in industrialized residential building systems was presented to the Workshop by Kurt Weissheimer of the Stirling Homex Corporation of Rochester, New York, one of 22 firms selected as Operation Breakthrough finalists by HUD. Weissheimer's summary was given in three parts: (1) a description of the present state of the housing production and distribution system and its traditional (that is, pre-Operation Breakthrough) relation to the national and local governments; (2) what response Operation Breakthrough has required of participating firms; and (3) what government-industry cooperation is required if Breakthrough is to move beyond the demonstration phase to become a permanent part of U. S. industrial and housing enterprise.

In its present state, the "archaic residential construction system makes no demands on government," suggested Weissheimer.

This appears so for three reasons: (1) there is no obvious draw-down of public or private resources, for although the production of houses does comprise a significant amount of economic activity when national aggregates are compiled, this activity occurs in "small chunks" in thousands of localities. Each "chunk" is small relative to the total economic activity of any single region; similarly, (2) there is no large displacement of or demand for social services (the load on schools, health facilities, etc.) because only relatively small numbers of new houses are built at any single site at any particular time. (3) The conventional housing "industry" elicits no continuing cooperative obligations from government because of the "industry's" atomistic, opportunistic organization--that is, the ease of entry and exit for the small builder: when housing demand slows, the beginning builder can readily withdraw from the field and rejoin the ranks of the skilled tradesmen from whence he came. Thus it is easy for the labor-intensive housebuilding industry to expand and contract with changing economic conditions. Operation Breakthrough hopes to introduce a systems approach to all this.

Operation Breakthrough, according to Secretary George Romney, is the Nixon Administration's program to "utilize modern techniques of production, marketing and management to provide housing for all income levels through a partnership of labor, consumers, private enterprise, and local, state, and Federal governments." Private firms were invited to compete for the opportunity to develop these systems.

Success in Breakthrough requires an ability to "respond across the system," and not in the piecemeal, fragmented ways of traditional building. This is the only way to achieve production in volume at one site. Stirling Homex can have 3,000 units ready for occupancy in six months. It can also identify and make 10,000 changes in a two-year production run of two-story townhouses. Only a firm in high volume continuous production is able to monitor and adapt new technology in this way. Such techniques enabled Stirling Homex to program and activate a 350-unit project in 30 days rather than the customary two years for a public housing project.

Weissheimer's final point--the new commitments that a high volume, nationwide industrialized housing program require of all involved:

1. A commitment to large-scale systems in capital plant and facilities, a commitment to large payrolls involving thousands of workers and a commitment to the numerous subsystem elements such as materials manufacturers and their suppliers, to tradesmen of all kinds and to the host of subcontracting enterprises.

2. A commitment over the longer term independent of cyclical swings that cost the present housing industry so dearly; a commitment over the long term between initial and concluding negotiations and over a term long enough to accomplish necessary site assembly; a commitment over a term long enough to permit sound planning for related urban services.

3. A commitment to government assistance to a whole range of households of different income. Direct housing subsidies would

no longer be confined to families with low incomes. The Kaiser Committee has estimated that of 26 million units needed by 1980, 6.5 million are targeted for assistance--this is housing for the poor--and will be built in aggregates large enough to make industrialized systems feasible. There is no market aggregator, however, for the 19.5 million units of medium and upper income units remaining. Much of this remainder will be priced beyond the reach of middle-income Americans without market aggregation which makes technologically-advanced housing feasible.

An elaboration on the economics of housing production and the need to transport large loads over long miles was called for. Weissheimer's reply was that industrialized housing cannot reduce housing cost but that, in an era of rising prices, volume production assures stability of price. This is so because a good produced for and distributed to national markets is removed from vagaries of local demand which fluctuates wildly in comparison to the smoother, slower, secular trend of national price rises. With respect to shipment: transportation over long distance was held practical if it beats competition.

Resistances to industrialized housing was also discussed; specifically whether Stirling Homex had built units in any "union" state? Weissheimer enumerated sizeable projects in three industrial states commonly considered "union" states: Ohio, New York, and Massachusetts. Important basic understandings have been reached with the several pertinent international unions--this is important for multi-state operations. But precise terms must be negotiated at each locale. Typical of such agreements is that recently entered into by the International Brotherhood of Carpenters and Joiners, who will now be able to organize within the home-manufacturing plants. Training and minority recruitment have been made a part of the package. The traditional villains--unions and codes--were held not to be the problems they're purported to be, although why this was no longer true was not made clear.

Juxtaposed to this concern with mass housing was the plight of a predominantly rural and small-town state, such as Vermont, in the face of a rush of residential construction. The state and its local governments are faced with large demands for services that housing brings. Specifically it is the cost of providing these services that has energized some localities to resist intrusion of much new housing in too short a time. (This is to be contrasted with the earlier call for "commitments" to large-scale action as being prerequisite to success in industrialized housing.) It was stressed that Vermont's case too is urgent, because of strong state and local support for environmental preservation. There is some hesitation at the prospect of Vermont being overrun with emigrants from its more populous, industrialized, urbanized neighbors. Zoning, subdivision regulation and environmental preservation must precede any national commitment to housing.

A national housing policy that went to fundamentals, including a 0 percent interest rate for housing mortgages, was called for. The Banking and Currency committees of both houses of Congress which oversee U. S. housing legislation were seen as more concerned with assuring the nation's fiduciary institutions of "no risk and 8 percent" than they were "a decent home in a suitable living environment."

Attention was called to the situation in the older, long-established cities. The critical shortage in developing new housing is lack of sites. In Boston, for example, it is no longer possible to assemble Title I (Urban Renewal) sites because "the federal government won't help." Assistance is not forthcoming for either the development of the air rights over the interstate highways or for the reclamation of marshes and waterfronts. Moreover, "Operation Breakthrough" was held to have written off central cities.

A defect of most existing subsidy programs is that they are invariably easier to apply to projects on previously undeveloped land whereas the older cities are almost totally developed. Nor is attention paid to maintaining existing housing. The FHA bureaucracy was specifically singled out as an obstacle that had best be "eliminated." FHA and its bureaucracy, however, have strong allies who have traditionally sustained it and have defended it from criticism; these allies are the savings and loans associations, the National Association of Homebuilders (NAHB) and the manufacturers of traditional building materials.

This problem was held to exist throughout the New England region, for almost all of the large, older New England cities are extremely densely developed and have extensive waterfronts now in disuse. Thus a regional land reform approach was seen as necessary. Acting against such an approach, however, is the lack of a national land-use planning agency. The National Resources Planning Board, which Congress eliminated during World War II, was the last such agency and might be a suitable model for a "Regional Land Resources Planning Board" for the New England area. State planning boards might assist in this effort.

Precautions against the possible harmful external or off-site effects of an industrialized housing program were called for. An immediate concomitant of residential expansion without adequate development controls might produce worse sprawl and an inefficient use of land resources. To avoid this it would be desirable to anticipate the most efficient uses of land and to then begin anticipatory land acquisition for that highest social use.

"Voluntarism" was seen as an unrealized resource of great potential utility in meeting housing problems. It provided agencies, particularly non-profit sponsors of middle- and low-income housing, with talents they couldn't otherwise obtain.

It was suggested that uniformity and modernization of multi-jurisdiction building codes would contribute significantly to a national program of technologically advanced housing. Uniform statewide building codes, incorporating performance standards and the training of inspectors to assure uniform enforcement would (1) facilitate market aggregation by eliminating conflicting local codes; (2) overcome one source of local resistance to the introduction of novel building systems; and (3) make feasible system-wide rather than merely incremental changes. Local codes and unions were seen by one participant as "red herrings" in that although they do constrain minor advances in building technology they were not the factors holding back the needed "system-wide changes." When cost reductions are great enough, local governments won't deter new systems for lack of code compliance.

Section F: Crime Control

"Police Resource Allocation Methodology"--Joel Edelman, The New York City RAND Institute

This case study involved an attempt to transfer the use of certain analytic skills, rather than hardware technology, by the New York City-RAND Institute (the Institute) to the New York City Police Department (NYPD). The "problem" to be solved was to help the City decide how to distribute the 3,000 uniformed patrolmen that were to be added to the NYPD quota during 1969.

Late in 1967 Mayor John Lindsay and his Budget Director, Frederick O'Reilly Hayes, asked the RAND Corporation whether it could provide analytic support to a number of City agencies. Like many other organizations, RAND was then growing increasingly concerned about urban problems. For a period of three or four months small groups of RAND researchers met with members of the Mayor's staff and with officials of various City agencies to see whether there was any match between the interests of the City in analytic work and the problems which RAND felt able to address. Four agreements emerged from that series of meetings. The agreements became contracts, and in January 1968 RAND established a New York office and set to work on problems of health, housing, fire protection, and police. Since that time RAND has begun studies on water pollution, correctional institutions, welfare, and the New York labor market, as well.

The research now involves some 85 professional analysts--roughly 60 full-time equivalents. The staff is drawn from a wide range of academic disciplines. Economists, mathematicians, operations researchers, and engineers predominate; they account, among them, for just over half our number. They are joined by four political scientists, two biologists, four lawyers, five city planners, two psychiatrists, four sociologists, and a number of others.

The agreement with the NYPD included research and analysis on several phases of police problems and operations--recruitment, training, promotion, command and control, use of detective resources, crime and called-for-service patterns, deterrent effects of uniformed patrolmen, and resource allocation. This case study was performed under the resource allocation heading.

During the Summer of 1968 Mayor Lindsay announced that the NYPD manning quota would be increased by 3,000 uniformed patrolmen. There had been pressures, both from the NYPD and from many segments of the public, to respond to recent significant increases in reported crimes by increasing the visible police presence. The question of how to distribute the additional manpower among the 77 existing police precincts was important for many reasons, particularly because it could very well affect the safety, fear levels, and political opinions of the citizenry.

This was not the first attempt to deal with this kind of problem or even with this specific problem; several methods existed or were being developed. The NYPD had an established procedure for allocating patrol manpower; the International Association of Chiefs of Police (IACP) had a recommended formulation; the St. Louis Police Department had just adopted a computer-based crime mapping and patrol allocation scheme that was highly regarded; and finally, a RAND team, led by Richard Larson, was developing a sophisticated computer algorithm for optimizing the deployment of NYPD's uniformed patrolmen.

The Police Commissioner requested that RAND give immediate consideration to how to allocate the 3,000 additional patrolmen. But because answers (or at least advice) were needed quickly, and because the existing methods were not exactly applicable to the problem in New York and a radical change in allocation method could not be accomplished quickly, RAND decided to develop an improvement of the NYPD's present method rather than a major conceptual change. The sources for our method were, first, the existing method and our knowledge of the existing legal, organizational, and practical constraints upon allocation; second, our knowledge of developments in the use of time-shared computers by laymen for immediate calculation or experimentation with stored models.

To understand our approach and why we chose to develop an interim method for allocating the 3,000 men, it is important to know the present method. The basic formulation is supposed to be the "hazard plan." This plan lists the following 9 factors: crimes against persons, all crimes, calls-for-service, population, area, juvenile delinquency, accidents and aided cases, school crossings, and licensed premises. Each factor is given a weighting percentage; the weightings add up to 100 percent (the two "crime" categories are 45 percent of the total). In the calculations the numerical value of each factor for each precinct is multiplied by the weightings to give a precinct total score. This score is supposed to determine each precinct's percent of the total allocation. But this formula is not applied to all precinct patrolmen. Beforehand, a large fraction of the force is allocated to "man" the patrol car sectors within each precinct; the number of sectors in each precinct, however, is not chosen in accordance with any recognizable formula. Thus, in fact, fewer than 50 percent of the patrolmen are allocated in accordance with the hazard formula.

There are several inherent problems with the formula method and with any one formula: they are input measures as opposed to output or performance measures; the factors are assumed to be the only important ones; no measures of effectiveness are calculated (there is no way of knowing how "good" or how "equal" the formula is); and any particular formula is arbitrary (there is little opportunity to do sensitivity testing). The formula approach does have the advantage, however, of being relatively easily applied and calculated with available statistics.

The technology RAND attempted to transfer included an allocation method which was a computerized "variable hazard plan" which allowed police administrators to sit at a time-shared computer console and experiment with different formulae and be able to see an immediate printout of the results. Together with the Department's Planning Staff, RAND identified eleven neighborhood characteristics which seemed important to the question of police deployment: total population, crime rate, number of street miles, arrest-rate, number of calls for police services, and so forth. RAND then developed a simple computer model which allows anyone using it to assign to each of those characteristics any relative weighting he considers appropriate. Given weightings, the computer automatically types out a detailed set of deployment figures, by precinct, for the 3,000 men. At the same time it calculates some predicted indicators of police performance under such a deployment--mean time for a car to respond to a call, workload per patrolman, and so on. A number of police officials have sat at the computer, supplied their own weighting schemes, and examined the results.

The allocation formula could be limited by any number of administrative constraints, and the printout included several measures of effectiveness and equality. For each precinct the following measures were calculated for every experimental allocation: projected response time, workload per patrolman, number of men assigned per crime, and probability of passing any given point in the precinct.

This method has the advantages of allowing police administrators to quickly see the allocation of any weighting formula, to see the projected effectiveness of a formula, and to take into account normal administrative constraints.

Although there was favorable discussion of the method at all levels, it was finally rejected in favor of using the results of the existing police allocation method. It is difficult to know precisely the reasons for the decision, but they certainly include the usual list--tradition, too little time available to convince officials of its usefulness, and the fact that the allocations arising from application of the formulae often did not meet police officials' intuitive standards of usefulness. More importantly, perhaps, was our different definition of "success." In applying the method RAND tended to look toward "equity" based on policing needs, effectiveness, and efficiency considerations, whereas we never had a clear idea of the police criteria (perhaps they did not either). A related problem was that without some accepted criteria there was no way to "prove" that either the allocation method or any result of it was better than what already existed.

RAND attempted to break down the barriers to this innovation by bringing ranking planners, field officers, and decision-makers into the process, both at its conception and through its testing. In fact, the use of time-shared computer consoles was for this very purpose. Furthermore, RAND kept other City officials, particularly in the Mayor's Office, informed of our progress and allowed them to operate the computer. They were very helpful in promoting the new methods, but their influence was not enough to alter the decision.

Lessons are not easy to learn, partly because of the feeling that we did most everything we could legitimately do under the terms of our agreement with the City. However, there is much that can be said about what preconditions must exist before such a successful technology (analysis) transfer. It is certainly helpful if some tradition exists, no matter how small, of using or dealing with relatively impartial analysis. The importance of developing this sympathetic attitude toward analysis cannot be overemphasized because its absence is at the root of so many unsuccessful attempts. There should be some internal (to the agency) incentives to analyze their present operations and future plans. Of course, it is the unusual governmental unit that has a built-in reward system for change or chancetaking, even if the potential benefit is clearly in the public interest.

In addition to the internal agency mechanisms there should be meaningful incentives provided by higher governmental authority and the agency responsible for budgeting. They have the means at their disposal to help assure that improved thinking and analysis is practiced in the operating agencies. They have the leverage to help assure high professional standards of performance and analysis.

A related problem, especially in municipal and state governments, is the civil service system. Although it appears to do relatively well in protecting the rights of governmental employees from arbitrary official action, the system does not foster needed innovations in operations or personnel. Many of the analytical skills needed to administer new procedures are relatively new and are not possessed by the persons who have finally worked themselves up to reasonably high positions in the agencies. Entry of persons possessing these skills is needed at all levels, particularly in the more conservative agencies at the middle levels. Local government is falling further behind than ever before compared to business, the military, and the federal government; it is becoming less and less tolerable, both to the taxpayers who pay the bills and to the citizens who require services.

Section F: Crime Control

Chairman: Douglas S. Lipton, Assistant Director, Office of Crime
Control Planning, State of New York

Recommendations

1. Better definition must be made of what communities expect of police. What values are police expected to implement and how?

2. Greater active involvement of local communities in police work is necessary so that both police and citizenry can better understand and reinforce each other.

3. Present structures of police departments and policing must be critically examined to assess whether the recruiting, assignment of roles, methods of operation and structures, are suited to current needs or whether entirely new structures are required.

4. Methodologies must be developed to create a climate of acceptance by police personnel of community involvement and of assistance in methodology from universities and industry.

5. Better understanding of the potential for crime prevention rather than just crime response must be developed.

Joel Edelman's summary of experience in attempting to establish a computerized allocation scheme for patrolmen in the New York City Police Department pointed up the difficulties which can arise when research methodologies and analytical techniques are attempted in an operating city department, especially a police department: "It should be noted that although there was favorable discussion of the method at all levels, it was finally rejected in favor of using the results of the existing police allocation method." He suggested several preconditions to successful technology (analysis) transfer: (1) a tradition of dealing with relatively impartial analysis or at least a climate of acceptance and trust that the results will be in the interests of the agency personnel involved; (2) internal incentives to analyze an agency's present operations and future plans; (3) incentives provided by higher governmental authority and the agency responsible for budgeting; and (4) personnel policies which allow the hiring at appropriate levels of persons with the requisite analytical skills for assisting in the performance of analysis, interpretation of progress and results to others in the agency, and further implementation after the outside consultants have withdrawn.

The ensuing discussion focused on three questions raised by Mr. Edelman's paper:

1. In what way and for what reasons did the Police Department seek aid by outside analysts (and to what degree was this imposed)?

2. How can the necessary climate of acceptance and cooperation be established for the introduction of technology in such an agency?

3. How can system improvements and innovations be implemented?

The Police Department studies, while initiated by the Mayor and his Budget Director, were supported by the Police Commissioner and involved from the outset the chiefs of Planning and of Operations. In a similar contract involving advisors to the Los Angeles Police Department, authority to review, approve, and implement new techniques was vested in a panel of chiefs in the department. By focusing decisions this arrangement also allowed some focus in educational efforts involved in interpreting proposals and achieved some success. Mr. Edelman reflected upon the possibility that the existence of a third party in their contract, the NYC Bureau of the Budget, created an over-the-shoulder party which may have had an inhibiting influence on relationships between NYC RAND people and Police Department people. There were RAND proposals which were adopted by the department, but generally in those areas where the RAND work offered technological support for something that the Police Department wanted anyway. Other interferences with the relationship between analysts and police included the lack of adequate RAND staff time spent in the middle and lower ranks of the department trying to understand and appreciate what the police are trying to do.

Police departments were held to be traditionally unreceptive to analytical techniques. Rigid discipline and respect for higher authorities in police departments make those in the lower echelons want to keep a "low profile" with regard to anything new which hasn't been passed down from above. Since very little introduction to scientific analysis or systems approches is provided in police schools, this area becomes one in which great caution is exercised lest one be found advocating something later denounced by a higher echelon. Police are also leery of the quantitative aspects of analysis; they either do not comprehend or refuse to accept the validity of quantitative measures which may be used to guide resource allocation.

The question was raised as to the criteria RAND and the Police Department employed in evaluating the usefulness of an analytical scheme or of its output. Mr. Edelman suggested that they were a bit "wide-eyed" in expecting to just come into a police department, ask what criteria (for best allocation of men) were being used, have these criteria volunteered, and proceed to help redefine and sharpen those criteria. His assessment was that police see the explicit definition of their activity by persons outside the department as threatening; they don't want to be limited or controlled by others who might do this if they had accurate information. To become measurable is seen as becoming vulnerable to external control.

The difficulties of applying technology in crime control was raised in the following argument. Given that a really inclusive description of the assignment process and its results could be devised--including such intangibles as neighborhood demands, the seniority system, and political pressures--such a system would be a better predictor of the location of crime than the more direct and quantitative model that RAND tried with the NYCPD. Such a model would appeal to RAND even more and to the NYCPD even less than the model that was tried. The basic problem as seen from the department was the risk of making too much information about their activity known to outsiders.

Corruption

The question was raised whether anyone could begin to implement technological improvements in police work and crime control in central cities before dealing with the issues of distrust of police and of the police corruption observed by ghetto dwellers. Several responses indicated that departments do typically have some mechanism for weeding out corruption, at least of the most blatant kind. In New York City, the Commissioner of Police uses confidential investigators. The key was felt to rest in command policy; a well-defined policy against corruption from the top can be most effective. Although "beat" patrols have sometimes been criticized in the past as vulnerable to corruption, it was nevertheless felt that that risk was worth taking in order to reestablish better rapport and mutual support between police and neighborhoods. For this reason the Los Angeles Police Department has recently set up a "basic car" plan whereby four policemen are assigned to a specific community for an extended period of time and are expected to become known in those communities.

Involvement of Local Community

Another question dealt with the use of local people for community policing. In the Bedford-Stuyvesant district of New York City, local residents, enraged over apparent inability of police to deal effectively with the drug problem, resolved to take over the job themselves (although with what results was unclear). Experiments in NYC and Chicago followed riots in those cities in which local teenagers were enlisted to report not only crime but bad street conditions and building violations. The NYC experiment ran into difficulty, however, when the teenagers became inadvertent intelligence sources for the police and therefore suspected as traitors by the community.

Later discussion brought out the observation that the monopoly control of police is being broken, that there are now more private police employed than public, albeit as peace officers. The prediction was made that within the next five years the nation would see a suburban community contracting with a private firm to provide the police services now provided by public police forces and with the advantage that their performance will determine whether the contract is renewed. Some participants were particularly alarmed at the prospect of police functions being out of direct public control even for the duration of an annual contract; others saw potential advantages in being able to replace an entire structure if it is obsolete or non-operational in terms of community goals.

Police Attitudes

The discussion turned to the question of police attitudes. On the basis of their work in New York, RAND researchers observed that even those policemen who enter the force with the most open and progressive attitudes could be seen gradually to be socialized into the more conservative and authoritarian attitudes of other members of the force. A cycle of recruitment was noted which draws upon persons from the working class with a socialization to authoritarian views who, in turn, move up in a department to insure the further recruitment of more persons like themselves. There is the basic problem of what society wants police to do. Dealing with physical violence is not a job for legal clerks.

Adaptation and new responses on the part of police was thought to be possible. Such a change was said to have occurred in the Chicago police force. Having learned something about how not to handle political confrontations from the August 1968 debacle at the Democratic Convention, the department, in successive weeks, met sporadic outbreaks of vandalism and looting on the 1969 anniversary of the assination of Martin Luther King with hard hats, billy clubs, tear gas and the rest, then met the challenge of a Vietnam protest parade with police--drawn, with the help of a psychologist, from a screening of the entire force to find the 500 "friendliest fuzz"--lining the parade route to "assist" the marchers.

Police Roles

Several participants commented on the multiplicity of roles police and police departments are expected to perform. Eighty percent of police time in NYC is spent in non-crime-related activity. There is a need to clearly differentiate the roles--for example, crime control, crowd and traffic control, medical emergency service--then to define "do-able" tasks and structure the training and personality of recruits to fit. Some advantages might remain, however, in leaving the police role ambiguous rather than reserving all our hostility for the isolated policeman whose job is to give traffic tickets or perform other similar tasks. Still, many police roles do overlap.

Goals of Crime Control

The question was raised whether the RAND effort had included an examination of the goals of the police department in NYC. Mr. Edelman responded that they had made an effort to engage the police command people in conversations about this issue, but to no avail. Another study is also being done in Cambridge, Massachusetts, under sponsorship of the Law Enforcement Association of America, seeking to probe both community and police views of their job and responsibilities.

The beat patrolman has a complex task. He is expected to enforce a whole host of laws, customs, mores--often without explicit direction from the community he is working in and without a coherent, consistent legal system he can fit precisely into. It was suggested that this is all the more reason for looking more critically at the present needs of society and at the adequacy of present police structures for meeting these needs. Mr. Edelman felt that it would still be possible to work within the present structures, but that the changes in that structure would have to be the result of outside pressures; he did not feel optimistic about changes initiated from within.

Finally, Chairman Lipton underscored the fact that the panel had been dealing only with the nature of response to crime, not with better understanding how to prevent the occurrence of crime in the first place. There seem to be no resources allocated to this task and no responsibility assigned to it.

Section G: Health Services

"Innovation in Health Care: A Case Report on the Use of Two-Way Television"--Robert J. Weiss, M.D., Professor and Chairman, Department of Psychiatry, Dartmouth Medical School

Innovations in medical care through the use of technology depend on asking the question and analyzing the question carefully. In this case report, we will attempt to show how the question arose, how it was analyzed, and then how the use of the technology became self-evident.

The Problem

The effort to narrow the gap between mental health needs and available manpower resources has focused much attention on the family doctor. He is the professional most likely to encounter the psychiatrically ill patient earliest in the course of his illness, and thus to be able to intervene at a time of great therapeutic potential. Many attempts have been made to improve the capacity of the primary deliverer of care to recognize, diagnose, and manage his patients with emotional illness. The National Institute of Mental Health has funded a program for the psychiatric education of general practitioners for over twenty years and at a current cost of approximately 10 million dollars a year. The results have been far from spectacular. Courses have been developed at medical schools throughout the country with uniformly consistent results. Approximately 7 to 8 percent of the potential physician audience, in any area, have attended the courses, and each year the same 7 to 8 percent attend. Evaluation has been given lip service, but no real hard data is available on the effect of the programs, either on the level of the physician's competence to manage the psychiatric patient or on changes in the patterns of care of the psychiatrically ill.

Physicians have complained about the inadequacy of psychiatric consultations, the long wait for appointments, the difficulties encountered in getting information about their patients from the consultants, and the lack of help in directing further management of their patients. They feel that referral results not in consultation, but in loss of their patient. The failure of the consultant to share information reinforced the family physician's own feelings of inadequacy in regard to the management of the psychiatrically ill patient and encouraged a tendency to ignore symptoms they couldn't treat until they were so florid that rejection of the patient and expulsion to a psychiatric hospital was the only possible course.

Practitioners are often reluctant to refer patients to medical centers or teaching hospitals because of a fear of criticism by the staff for an incorrect referral. Or, they are asked to make a judgement regarding the appropriateness of the consultation which requires a sophistication of knowledge which if they possessed it, would negate the need for the consultation.

The final problem is the requirement of attending a course which is seen as dealing with material which is, in today's parlance, "irrelevant." Physicians want to learn about problems for which they are responsible.

Thus, the problem can be summarized as finding a way to provide psychiatric teaching to family practitioners on an immediately available basis, around problems of management of their cases, without taking the patient out of the community or out of the care of his physician. A system designed to solve these problems had to be easily accessible to the family practitioner and the psychiatrist consultant. It had to be able to be utilized on a twenty-four hour a day, seven day a week basis, and had to provide immediate backup support to the physician, although there would be no psychiatrist in the community. Teaching had to be accomplished on a case basis around the problem of immediate concern to the family practitioner, and the psychiatrist had to have ready access to the patient in order to obtain the information on which to make judgements about the care to be given. Since psychiatrists are concentrated in urban areas and not in community hospitals, the system would have to provide a means of bringing the patient to the psychiatrist and the psychiatrist to the patient. If the family physician was to be an observer, the system had to provide a way for the doctor to observe the consultation process and to discuss his case management with the psychiatrist consultant.

The problem was reduced to a communication problem of seeing and hearing since these are the two major dimensions in psychiatric evaluation.

The result was the decision to try to establish a two-way closed circuit television link between the Department of Psychiatry at Dartmouth Medical School and a community hospital in Claremont, New Hampshire, 26 miles away.

The method of operation is to have a psychiatrist on call 24 hours a day, to respond to any request from a physician in Claremont who has a patient with whom he thinks he can use psychiatric assistance. The doctor arranges to bring his patient to the Claremont hospital, and he goes to a studio equipped with a camera and monitor mounted on a stand. All the equipment is activated by one switch, so that no technician is needed. The doctor talks to the psychiatrist about the problem as he sees it and the psychiatrist is able to ask for pertinent background material from the physician. The doctor then brings the patient into the room and introduces him to the psychiatrist seen on the monitor. The family physician then goes into an adjacent room where he can observe the interview on two tandem monitors.

Following the interview, the patient leaves the studio and the family physician returns. The material is discussed, and a plan of management is worked out. Immediately following this procedure, the psychiatrist sends a complete written report of the consultation to the physician. Every effort is made to keep the patient in the care of the family physician and in the community. The physician is at liberty to request another consultation on the same patient at any time he feels it might be useful. No constraints are placed on him regarding selection of patients. In order to reduce the resistance of the physician to spending an hour in observing and participating in the consultation, no charge is made for the psychiatrist's time. However, the physician may charge his patient for the time he spends.

The problem and solution were suggested by the scarcity of psychiatrists in the northern New England area, poor public transportation, and low density population, which would not support specialty care in small community hospitals. The idea was conceived in 1960. No work was done on implementation for five years because the Department of Psychiatry had just been founded and was not strong enough to take on the research and service responsibilities which would have been entailed. No funds were available for exploration of the technical feasibility of the project and the New England Telephone Company was not equipped to give the technical consultation necessary. An abortive attempt was made to obtain funds from a small foundation in 1965, but the grant application had to be withdrawn when the New England Telephone Company repudiated the rate quoted by one of its engineers and doubled the rate. In 1967, with the assistance of the Lake Systems Company of Newton, Massachusetts, an owned and operated system was designed and a grant application was submitted to the National Institute of Mental Health.

The project was submitted as a four-year research application with an evaluation designed by a social scientist who was to be completely divorced from the operating aspects of the program. Difficulties were encountered from the site visit team, who felt that the project should be done as a demonstration without an evaluation. A firm stand was taken of refusing to proceed without a full scale evaluation built into the project.

Negotiations were begun with the staff of the Claremont General Hospital. Much suspicion and hostility was initially encountered from the staff physicians. The hospital board and administrator were cooperative since they saw an opportunity of getting something without an investment other than space. Negotiations with the physicians proceeded over several months until the physicians were reassured that the project was intended to benefit them, and would be oriented toward helping them in the management of patients who presented problems in their own practice. The fears of self-exposure, criticism from the expert, and involvement with an academic institution were major hurdles to overcome. A carefully planned series of meetings permitted the physicians to work through their fears. The plan of the project which provided them with the opportunity of charging for their time and having the consultations at the times they arranged, as well as being available for continuous support, all helped to change the climate for acceptance.

The research design provided for the collection of background data on the physicians' knowledge of psychiatry and attitudes toward the mentally ill over the first grant year. Base line data on patterns of care of the psychiatric patients in Claremont was also to be gathered during the first year. Instruments to measure attitudes and knowledge had to be developed and tested on a broad sample of physicians in New Hampshire and Vermont. During the standardization process, over 30 hospital staffs were given the attitude scales. In each instance, fear and hostility surfaced and was epitomized by the question "when are you going to take our licenses away?" This was said despite assurances of anonymity and that these were attitude tests, with no right or wrong answers.

At the same time that negotiations with the Claremont hospital were going on, Lake Systems were designing the studio system. It was decided that, while an owned and operated transmission system was feasible, it would entail site development, land acquisition, and an FCC license application. It also became apparent that initial installation costs would be higher than estimated. This was because no funds had been available for an engineering consultation and survey prior to the grant application.

An approach was made to American Telephone & Telegraph for this involvement in the project by taking over the transmission system. Several meetings were held at the vice presidential level with the result that American Telephone & Telegraph became enthusiastically involved and directed New England Telephone & Telegraph to assign personnel and construct the transmission system on a lease arrangement.

The operational phase began on December 19, 1968. After a year of operation, the overall impression has been that the technology has lived up to our expectations. There have been ample funds in the grant as well as additional funds from a research contract with American Telephone & Telegraph.

The summary of the project activity reveals that the base line data on attitudes which were validated on over 300 physicians in rural New Hampshire and Vermont should give reliable data on the effects of the program on changing attitudes of the family practitioners toward the care of the psychiatric patient. Over the first year of operation, 141 new psychiatric patients were interviewed and a total of 216 interviews were conducted. The evaluation is being conducted under the direction of a sociologist who has no direct connection with the operational aspects of the program. The evaluation of changes in level of knowledge are being conducted by an ongoing content analysis of the interchanges between the psychiatrist and the family practitioner. All of the interviews are recorded on a split screen video tape and are then content analyzed. The exact measures of change are not known to the psychiatrists in order to minimize the danger of contaminating the evaluation. Yearly follow-up interviews have been conducted and indicate a high degree of satisfaction on the part of the physicians. The relationship between the medical school and the practicing physicians is markedly improved.

There are other indicators of change in patterns of patient care. Of the 141 patients seen, approximately 90 percent were severely ill psychiatrically. But, 84 percent of all the patients were treated in the community while the other 16 percent were referred to the Dartmouth Hitchcock Mental Health Center.

In the year-end interviews, the physicians expressed great enthusiasm for the project and indicated changes in how they were handling their psychiatric patients.

The TV link has also been used for a biweekly Tumor Conference. The physicians in Claremont have presented problem cases and a consultant has viewed the x-rays and other information and conducted a teaching conference.

A course for intensive care unit nurses has been run for the Claremont nursing staff by the Hitchcock nursing instructors.

Other utilization has been kept at a minimum in order to eliminate the possibility of contamination of the results of the primary research project.

The possibility of reorganizing some aspects of the medical delivery system in urban, suburban, and rural areas has been enhanced by the results of the project so far. The value of the communication link has just begun to be evaluated. There is a real danger that the principles of the project will be applied to other problems in medical care and education without evaluating each new use or application. The tendency to institutionalize innovation before knowing whether it is really doing what one thinks it is doing continues to be a greater problem than innovation itself. Evaluation must be conducted in as rigorous a fashion as possible. In the area of health care the multitude of variables makes such evaluation even more necessary, albeit more difficult. Governmental agencies must be more demanding regarding evaluation and must make sufficient funds available to insure the adequacy of the evaluation research.

It is apparent that a feasibility study could have been done prior to submission of the grant application had $5,000 been available. It is an anachronism in the whole field of service research and demonstration that it is easier to get $400,000 for a project than to get the $5,000 to do a feasibility study prior to the submission of a grant application. Such studies should be funded by governmental agencies at all levels and should be granted with more ease than the research or demonstration funds.

Finally, it is apparent that the successful use of technology is not just dependent on the capacity of the technical. The success will depend on whether the right questions are asked about not only the technological, but also the sociopolitical problems. Innovation remains a problem in overcoming resistances and reassuring those who will be threatened by the innovation.

Section G: Health Services

"Improving Health Care Through Voluntary Regional Cooperation Programs"--Philip Donham, D.C.S., Arthur D. Little, Inc., Cambridge, Massachusetts

Regional Medical Programs was one of several federal programs that were initiated in the eighty-ninth Congress in 1965 to respond to the growing health problem in the United States. Its contribution was expected to be to unlock the vast storehouse of medical research that had accumulated over a decade or more and make it available to victims of the killer diseases: heart disease, cancer, stroke, and related diseases.

As the Congress finally passed the Law (P.L. 89-239) it conceived of regional voluntary cooperative programs as the most effective vehicle for facilitating the movement of advanced technology through the medical system. When the regions began to operate, several unexpected conditions slowly emerged: (1) to the extent that new technology had real applicability to primary health care, it was already very widely known throughout the system; (2) obstacles to the application of the latest technology to patients were either economic or institutional for the most part; (3) when economic, they were usually beyond the anticipated financial resources of RMP to deal with beyond a token level (and other agencies usually had a more direct responsibility for them, as with renal disease); and (4) RMP was ideally situated to work on the problem of institutional barriers because of its charter to build on cooperative arrangements among all those participating in or closely related to the medical system.

Regional Medical Programs has found itself able to turn in the direction of facilitating closer relationships and improving communications across institutional barriers without having to abandon the professional orientation it started with.

Regional Medical Programs has thus become a significant practical example of how a public program can learn and evolve as it develops, so that it can be responsive to reality while pursuing its valid social objectives.

The Original Goal: Improved National Health Care

In 1965, the Congress of the United States acted on the emerging awareness that the state of the nation's health was unacceptably poor even after billions had been spent on medical research. That was the year that the Congress established Medicare and Medicaid to help old people and poor people meet their medical bills.

In the same year, two laws designed to improve the capability of the medical provider system were put on the statute books. The Regional Medical Programs (P.L. 89-239) dealt with improving health care for victims of heart disease, cancer, stroke, and related diseases through voluntary cooperative arrangements among those directly concerned with medicine. The other, Comprehensive Health Planning (P.L. 89-749), dealt with state and area-wide planning of health resources to optimize their effective application.

The Commission on Heart Disease, Cancer and Stroke, which was established by President Johnson in 1964, included in its recommendations the building of a number of "regional medical complexes" around the United States for research and training and for demonstrations of patient care in the fields of heart disease, cancer, stroke, and other major diseases.

Implicit in the report were two beliefs that have since undergone careful scrutiny and, at least in some quarters, strong challenge: (1) Effort spent directly on the leading killer diseases is the most promising way to improve health statistics quickly; and (2) Regionally organized medical complexes could force feed the entire medical system with knowledge that had built up in the great medical research centers.

The administration bill had very hard sledding in the Congress. There was wide resentment in the profession at the suggestion that excellence and the latest medical knowledge were attributes confined largely to research centers. There was also widespread fear that this was a first step toward a federal medical system directed from Washington.

The Act as passed (P.L. 89-239) turned away from the idea of a detailed federal blueprint for action. Specifically, the network of "regional medical complexes" was replaced by a concept of "regional cooperative arrangements" among existing health resources. It recognized geographical and societal diversities. It established a system of grants to enable representatives of health resources to exercise initiative in identifying and meeting local needs within the area of categorical diseases. "Other major diseases" became limited to "related diseases." How well local health resources can take the initiative and work together to improve patient care for heart disease, cancer, stroke, and related diseases became a measure of the degree to which the various RMP's would be perceived as meeting the objectives of the Act.

RMP as a Vehicle for Disseminating the Latest Medical Advances to the Patient

By the time the Regional Medical Programs came into being, its objectives had been spelled out in the law as follows:

> The program was expected to encourage research and training (including continuing education) and related demonstrations of patient care in the fields of heart disease, cancer, stroke, and related diseases.
>
> The program was expected to afford the opportunity to the medical profession and medical institutions of making available to their patients the latest advances in the diagnosis and treatment of these diseases.
>
> The program was expected to improve generally the health manpower and facilities available to the nation.

RMP, it would seem, was given responsibility to seek out the latest medical advances and find ways to disseminate them for the purpose, so far as possible, of wiping out heart disease, cancer, stroke, and related diseases.

Fifty-five planning grants covering every part of the United States were approved by the Surgeon General between 1966 and 1968.

While each region went about organizing and planning in its own way, they all turned almost immediately to the medical schools for access to the latest medical technology that they were expected to help disseminate. The medical schools, by and large, were ready and waiting.

Hopes and expectations ran high in some quarters. There had been considerable publicity given to the truly marvelous medical research being carried out in medical schools and research centers across the country. This brilliant research had resulted in exciting --even dramatic--advances in dealing with what had previously been obscure or untreatable diseases.

As the Regional Medical Programs turned to these institutions for the latest advances to be disseminated, the astonishing thing was that virtually no new technology appeared in their grant proposals. Their ideas were almost universally confined to ways of using RMP funds to make already widely known technology more readily available to local physicians and community hospitals, e.g., coronary care units, audio-visual teaching tools, assistance in multiphasic screening, and a broad spectrum of continuing education programs, from conventional to creatively new. But the expectation that there was a storehouse of unrecognized advances in medical technology, ready to be applied by the medical profession as fast as they could be made aware of them, proved to be a myth.

There could be no quarrel with the kinds of projects that were approved. Clearly they dealt directly with the objective of making what was known more readily available to the patient.

Recognition of the fact that dissemination of new technology must, in the face of reality, drop back from a position of top priority came slowly. It is the nature of things that professionals in medical schools are better positioned to take the time to prepare grant applications than those more immediately tied to patient care. As might be expected, applications from medical schools dominated the scene in the early years of the program. To some degree this seemed to support the notion that RMP was a tool of the medical schools to disseminate their "superior knowledge," and it concealed from general notice for a while the fact that little of this knowledge was really an advance in the state of the art. There are still those in medicine who find it difficult to accept the reality that has emerged.

RMP as a Facilitator of Processes to Improve Patient Access to Health Care

As technology transfer dropped from a position of top priority, those concerned with the establishment of policy and program in the Regional Medical Programs began to look at the law with a new perspective. They recognized that the law put initative in the regions and with it responsibility to set new priorities.

Public Law 89-239 made it clear that RMP was to focus its energies on making quality care available to the victims of heart disease, cancer, stroke, and related diseases. It placed the profession in the forefront of the program.

A very significant emphasis on voluntary cooperative arrangements had been added before RMP became law. While medical centers and clinical research centers were to play an important role, hospitals, practicing physicians, and other persons and institutions related to medicine, as well as laymen familiar with the need for services, were to be included as active voluntary participants. Regionalization began to take on new meaning.

If lack of general knowledge of new medical technology was not a prime cause of the poor health statistics of the country, then "Where is the gap between our obviously superior medical knowledge and the observable level of delivered health care?"

It was at this point that the wisdom of the Congress in insisting on regional cooperative arrangements finally became clear. In the process of trying to get all interested parties to cooperate, the RMP's quickly discovered that the medical system is the victim of its own institutional barriers: mutual town/gown distrust, "guild warfare," defensive referrals, neighboring community hospital rivalries, and other serious interferences in the free flow of the most appropriate care to the patient.

The concept of mutual confrontation of common problems was essentially a new one, only just approaching a level of acceptability under the enormous pressures that had begun to beset everyone connected with medicine. And only RMP, of all the public programs in being, offered a charter to the medical profession to voluntarily address itself to lowering those institutional barriers. Here, then, began to emerge a new sense of mission in the most advanced RMP's.

This new mission led naturally to a need to learn where the system of delivery of health care was failing to reach people. Almost immediately, attention was drawn to the poor, both urban and rural. Whereas the middle income and well-to-do are suffering the effects of the institutional barriers referred to earlier, the poor are really cut off from the mainstream of the medical system even when covered by Medicare and Medicaid.

Indeed, if the medical profession is intent on raising U. S. health statistics to a level equal to the best in the world, they cannot do it without directly confronting the problems of the poor and the nonwhites. And the Regional Medical Programs is the only ready vehicle through which all medical professionals can join forces in that confrontation.

Speculations About RMP

RMP will almost certainly shift its center of gravity toward the outreach of the medical system away from the medical centers. Indeed, this has already begun in most regions.

As was mentioned earlier, medical schools assumed a position of dominance at first in most RMP's. In a much smaller number of cases regional medical societies took the lead at the start. However, individual regions were required to engage a broad spectrum of participation both as to occupational background and as to geographical spread.

The interaction of many professional subgroupings and many diverse geographical interests resulted in tensions and conflicts which were destined to bring about change. The required cooperation led to the thrashing out of issues. There was an awakening awareness that interaction among diverse groups, undertaken in a spirit of cooperation, could lead to creative solutions to health problems.

Region after region discovered that a balancing of interests was more attractive and productive than submission to the dominance of any one group. Reorganizations of boards of trustees, executive committees, and even of regional advisory groups became commonplace after a year or two of experience; and interest in subregionalization began to mushroom around the country.

As new groups of people began to pick up interest, formerly dominant ones moved back to a relatively less active role. All this has resulted in a clarification in each RMP of its program objectives. Within the last year there has been a considerable move in this direction.

RMP will come to believe in and rely more on the quality of local doctors and the capacity of associated medical personnel to take on greater responsibilities.[*] It came as a surprise to most to discover that excellence is not simply a quantitative accumulation of technical medical knowledge. First-line doctors, it turns out, know some things about patients that the teaching hospital specialists get little exposure to. The "whole man" concept of the local M.D. and some of the paramedical professions has a lot to do with the sense people have of how good their health care is. On the other hand, the repetitive experience of those who specialize in the larger institutions sharpens their skills in diagnosis and treatment of the particular diseases that they have chosen to focus on.

Local doctors usually find themselves treating patients; teaching hospital specialists most often find themselves managing difficult diseases. Both are needed; both call for trained skills.

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[*] The shortage of doctors will force this in any event.

Neither one is by definition more "excellent" than the other. RMP includes them both.

RMP is unlikely to become a powerful force in the economics of medicine. In any foreseeable future, RMP funding is unlikely to exceed 1/2 of 1 percent of the total expenditures for health care. At best its role will be facilitative and catalytic. The significance of project grants will continue a change that has already begun: it will be just as important that a project contribute to a strategy of building improved medical system relationships as that it be professionally sound.

The medical system of the United States is on a collision course. Soon, from one source or another, nearly everyone will have money to pay for adequate health care.

But there is a severe and growing shortage of doctors, nurses, and other auxiliary medical personnel even without the new patients who will come to expect care. Even if we were to double the enrollment of our medical schools and train other medical personnel at a significantly increased rate over what is now being done, in ten years we would no more than hold our own in a position of short resources.

There can be no doubt among thinking men but that public pressures will force some degree of rationalization of our medical system starting in the near future. Since what we are now doing, even if accelerated, will not meet the need, it is clear that new concepts, new relationships, new definitions of professional responsibility will come into being under this public pressure.

If the medical system is to be as radically changed as this suggests, the profession would be well advised to prepare itself to participate in the design of what will take the place of the present system. Medicine is highly technical, and professional participation in the design of the system is imperative if the design is to provide adequate safeguards of quality. A system designed by administrative men or money managers would be likely to exert pressures in favor of the quantitative rather than qualitative aspects of health care. Incentives would likely be conceived of in these terms, and personal advancement within the system would almost inevitably become responsive to these quantitative measures at the expense of quality. Medicine could easily be the victim of a kind of Gresham's law, reducing everything to the lowest common denominator.

All elements of the profession should be involved in any systems redesign, if what comes out of it is not to be warped all out of shape by special interests. Consumers, too, must participate in deciding what is needed. Regional Medical Programs is at the present time the only institutionalized arrangement for bringing all of these elements together. And it does so in a climate of cooperation and voluntarism that will prove invaluable when it comes to destroying old prejudices and building anew.

Section G: Health Services

Chairman: A. L. Chapman, Director, Bureau of Planning, Evaluation and Research, Department of Health, Commonwealth of Pennsylvania

Recommendations

1. The establishment of medical technology should be based on the establishment of goals which are carefully and precisely defined by health professionals and consumer representatives.

2. There must be more adequate evaluation of experimental projects in order to avoid the wasteful adoption nationally of ineffective approaches, as has happened in the past.

3. The problem of securing the acceptance of new technologies by the groups working with and affected by them must receive more systematic attention. Overcoming the political and institutional barriers to acceptance of existing technologies is more important than developing new technologies.

4. We must proceed beyond talking about technology as a single, all-inclusive concept. We need to specify different types of technologies and identify the political problems and solutions appropriate to each.

The focal questions of the conference--What are the potential applications of technology? What are the different types of obstacles to effective application? What institutional arrangements would facilitate application?--were introduced. The session brought participants' attention to bear on these issues, but failed to provide concrete answers.

The question was raised of the method of paying the psychiatrists participating in the Claremont Project. Dr. Weiss replied that they were paid through an NIMH grant. The project was conceived in 1960. It had been very difficult to get funds for a feasibility study, but little trouble had been met in acquiring support for the experiment itself. The average time for a consultation was one hour, which was considered highly efficient. The doctors did not resent the amount of time involved. It was held economically feasible to enlarge the scale of such programs. The same system could also be used purely for consultation without any conscious educational objectives.

It could also be used to economize on the available supply of subprofessionals, e.g., psychiatric nurses, although the usual problems of deciding who is qualified to administer medication would arise.

Dr. Weiss cautioned that this procedure not be institutionalized before one has a clear idea of the specific medical objective of how effective the procedure is for that specific purpose. The technique should not be used in other ways without evaluation of each separate application. Funds to support such analysis are hard to come by.

It was not possible to provide precise estimates of cost per patient under the Claremont procedure, because it was a research project with the extra expenses incurred in such an undertaking. The equipment was leased at $1,100 per month, but was not being used to anywhere near its capacity. Since every state is blanketed with educational TV, it would be easy to tie into such a system. The cost of equipping a studio is about $7,500 for black and white TV. The technique is less expensive than that of maintaining a psychiatrist in a community like Claremont.

Mr. Dunham augmented his presentation by citing examples of operational R.M.P. programs. In Delaware practicing physicians were brought back to the medical schools for refresher courses while their academic colleagues returned to practice in small communities. The faculty returned to their posts saying they had learned more out in the hinterlands than they were teaching at home. This process amounts to facilitating institutional change, breaking down the barriers, getting the guilds to recognize each other's worth.

An R.M.P. project also provided a rural New Mexican community with medical care by giving a nurse additional training and establishing a telephone hot line for her to doctors in Albuquerque. She can handle, and is allowed to treat, 85 percent of the cases that enter this rural clinic. When she has questions about a particular case, she phones the doctors and discusses the situation. Usually they can give her instructions over the phone. Occasionally they decide to transport the patient to Albuquerque. This project required breaking down the guilds and destroying traditional notions about who can treat a patient for what.

The point was made that if the major problem is delivery not to regions, but to much smaller units, then R.M.P. misses the true areas of need. The only sort of community representation is of members of the public who are familiar with the poor's need for services. True representatives of low-income communities are not included. Mr. Dunham remarked that community representatives tend not to come to meetings and that we do not know how to improve their attendance. The poor, when asked, say they want the kind of care everyone else is getting. They want standard middle-class medicine before they want to be the objects of experimentation. A health service program in Philadelphia with a registration of 15,000 was said to support this view. The patients from this poor community are satisfied and they use the services. Medical schools were said to discourage cooperation and team practice. Instead they produce god-like figures who do not communicate well.

Mr. Dunham added that we must start with changing the criteria for admission to medical schools. He reemphasized that it is impossible to generalize accurately about the R.M.P. because local variations are so great.

Exception was taken to the comment that community representatives to health committees do not attend meetings regularly. If they are absent, one has to ask why and look at what may be causing this tendency. The two formal papers were criticized for not talking about the people who are getting the care. Dr. Weiss concurred. He decried the psychiatrists' preoccupation with elite problems and commented that poor people are trying to tell us that they want first-class service. Criticism was also voiced of the physician's general reluctance to "put in the nurse." They are highly trained professionals, who can fulfill many tasks now reserved to M.D.'s.

The problem of bringing technology to people who can use it was brought out in the context of the relations between the Harvard

Health Plan and the Mission Hill-Parker Hill community in Boston. The Plan decided to locate its offices in Kenmore Square at the same time its representatives were negotiating with Mission Hill-Parker Hill residents over the location of an outreach center staffed by a physician in their neighborhood. Harvard agreed to the establishment of an outreach center, but suggested a nurse plus a minibus for carrying patients to see a doctor at Kenmore Square. The community and the professionals were operating under different logics. Neither was wrong, but unless greater interaction occurred between these groups, little good would come out of new technologies.

Thomas Sheridan of the M.I.T. Department of Mechanical Engineering voiced concern over the attitude of negativism and know-nothingism expressed during the session about technology. He gave an example of successful application of technology, the telediagnosis project installed at Logan Airport, connecting Logan with Massachusetts General Hospital. To date 1,700 patients have used the facility. Professor Sheridan distinguished between software, hardware, management alternatives and community values. Somehow we must straddle all of these and talk about all of them at once, but keep clear the differences at the same time. The hangups are not technology or patient acceptance, but primarily doctors' acceptance. Doctors fail to see TV's interactive capacities. The telephone system is being souped up to the point where it will be possible to carry TV signals. Another drawback is that doctors do not like to examine patients as if they are ten feet across the room. This might be overcome perhaps by using cameras which can be stuck into body cavities.

Dr. Chapman suggested that the equations voiced during the meeting had included an item so unknown as to make the equations useless. People's acceptance is the key unknown factor. We must think of the technology of manipulating people. This type of technology is not competitive with hardware, but rather makes effective use of hardware more feasible.

Section H: Education

"Applying Computers and Educational Technology to Individually Prescribed Instruction"--James W. Becker and Robert G. Scanlon, Research for Better Schools, Inc.

Individually Prescribed Instruction

Individually prescribed instruction (IPI) is an instructional system based on a specific set of educational objectives, and has correlated to these objectives diagnostic instruments, teaching materials, and methods.

Since the IPI curriculum is based on a carefully sequenced and detailed specification of educational objectives, these objectives are used in planning most other aspects of the instructional system. Lesson materials, teaching methods, instructional settings, and diagnostic tests--as well as the monitoring systems are--are geared to the instructional objectives, thereby permitting pupils to proceed quite independently.

IPI is a major break from the traditional classroom setting. A completely new instructional role for the teacher has been structured. All too often in the past the teacher has served as the final authority and as a dispenser of information to students. In contrast, IPI is organized so that the teacher becomes a manager of a system for instruction, a diagnoser of learning problems, and a prescriber of instructional materials and setting.

Perhaps an over-exaggerated definition of IPI would be to state that it is the utilization of humans to simulate in a manual paper mode that which can be accomplished by the computer and the best of our automated technology.

Little doubt remains in the minds of those who have invented and experimented with IPI that we are talking about an evolutionary approach in education, an approach which ultimately will take full advantage of research and development techniques as well as the emerging technologies.

A basic aspect of IPI is a rather detailed provision for diagnosis of pupil skills and abilities and continuous monitoring of pupil progress. Detailed diagnosis is made of the initial state of a learner coming into a particular instructional situation. Four types of assessment instruments are used in IPI. They include: placement instrument, used in locating students on the learning continuum; pre-test of each unit of work used to measure the specific objectives within a unit; post-test of each unit to determine mastery; and Curriculum-Embedded Tests measuring progress toward an objective.

A unique feature of IPI is its requirement that each pupil's work be guided by a written Prescription prepared to meet his individual needs and interests. The Prescription is an important two-way communication link between the student and the teacher. The teacher communicates to the student the choices made in different materials and different settings to achieve an objective. Information about student progress is communicated to the teacher through the Prescription. For the initial Prescription the teacher will generally consider the following factors: (1) the ability level of the child; (2) the general maturity of the child; (3) the type of learner; and (4) the student's reaction in various instructional settings.

The student generally begins work independently on the prescribed materials. Most of the students can proceed through the prescribed materials with a minimum of teacher direction and instruction. When assistance requiring extended explanations or instruction is required, the teacher gives such assistance. In order to free the teacher for instructional decision-making, tutoring, and evaluation of student progress, the scoring of materials, tests, and the tabulation of the student data are done by teacher aides or in some cases by the children themselves.

Inherent in the design of the IPI system is its capability for improvement. An essential aspect of individualized instruction is the provision for charting the progress of each student as he moves through the curriculum and the availability of these reports for teacher use. This information is necessary for individual prescriptions and classroom organization. The data to be used for prescription writing should include: (1) general ability level in the given subject; (2) the degree of mastery or lack of mastery in each skill in the particular unit assigned to the student; (3) information related to the child's progress in previous units directly related to the skills in the present unit; (4) detailed information related to the pupil's progress as he moves through the various tasks related to the particular skill or objective assigned; and (5) general learning characteristics of the pupil as they relate to the assigned task.

Information needed by the teacher for day-to-day classroom organization must include: (1) level, unit, and skill of each pupil in the class; (2) the approximate length of time (days) the student has been working on a given skill; and (3) the next immediate skill for each pupil in the class. With this information the teachers can organize the classes for small and large group instruction, peer group discussions , or individualized tutoring. The availability, accuracy, and format of these reports is the key ingredient to the success of IPI.

Furthermore, these data are used for continual evaluation and strengthening of the curriculum and instructional procedures, permitting the developers to constantly improve the system.

The model, as developed, considers the following aspects of instruction as they relate to the individual: (1) detailed specification of educational objectives; (2) organization of methods and materials to attain these objectives, including a variety of paths for attainment of mastery of any given objective; (3) a procedure and process for the diagnosis of student achievement in terms of the educational objectives; (4) individual daily evaluation and guidance of each pupil including a system for individually prescribing the learning task that the student is ready to undertake; (5) provision for frequent monitoring of student performance in order to inform both the pupil and the teacher of progress toward an objective; and (6) continual evaluation and strengthening of curriculum and instructional procedures.

The Learning Research and Development Center at the University of Pittsburgh is the creator of individually prescribed instruction and specializes in the research and basic design of new educational technology.

Individually prescribed instruction was developed by Drs. Glaser, Bolvin, and Lindvall with the cooperation of the University of Pittsburgh and the Baldwin-Whitehall Public Schools of suburban Pittsburgh, Dr. W. R. Paynter, Superintendent of Schools.

During the school year of 1963-64, the Learning Research and Development Center and the Baldwin-Whitehall Public Schools initiated an experimental project to investigate the feasibility of a system of individualized instruction in an entire K-6 school. This came about as a result of a series of prior exploratory studies, begun in 1961-62, designed to test preliminary notions on a smaller scale in a single classroom. The work started with the use of programmed instruction in an intact classroom.

As work proceeded, it soon became apparent that the significant individualization feature of programmed instruction could not be mainfested unless the intact classroom changed its organization to permit a more flexible progression.

As a result, a second set of studies was instituted, using programmed instruction and other materials in a more flexible context. Out of this experience grew the individually prescribed instruction project currently in progress, in which various combinations of instructional materials--including programmed materials and special workbook and test procedures--and teacher practices are being used for the purpose of adapting them to individual student requirements.

Research for Better Schools, a Title IV Regional Educational Laboratory, has the major responsibility for the field development, field testing, and dissemination of individually prescribed instruction.

Included in this responsibility is the study of problems encountered in a variety of institutional settings. It also includes the investigation of the strategies that are necessary for widespread dissemination of IPI. This activity is of major proportion, since the task of implementing this type of instruction in a variety of ongoing school programs is quite different from that of implementing IPI in the Oakleaf School.

Automated Learning Management System (ALMS)

Research for Better Schools, Inc., in cooperation with the Westinghouse Learning Corporation and the Quakertown Community School District in Bucks County, Pennsylvania, has been developing an Automated Learning Management System (ALMS) for individually prescribed instruction (IPI) in elementary mathematics. Unlike computer assisted (or based) instruction, the technology is currently available to handle what some researchers-developers refer to as computer managed instruction. RBS prefers the acronym ALMS because the implications for individualizing instruction go far beyond much of the current writing in computer managed instruction.

The initial objective of ALMS is to provide classroom management information for the teacher on the individual learning procedures for the individual student.

Two broad areas of concern at the base of developing such a system are: How do teachers make learning prescriptions for youngsters? How do teachers diagnose the learning difficulties youngsters may be having? Hopefully, teachers will begin to ask pertinent questions about youngsters and researchers will develop the necessary information files for the teacher.

Computer Assisted Instruction (CAI)

Since October of 1967, Research for Better Schools, Inc., and the Division of Instructional Systems of the Philadelphia School District have been cooperating to adapt individually prescribed instruction (IPI) mathematics materials to computer assisted instruction (CAI).

RBS attempts to keep up-to-date information based on some of the leading technological advances. Such information, when processed properly, allows the corporation to make wise investments. The following description traces the how and why of the RBS-CAI activities.

Working with computers can be an expensive business. To date, the total budget of the Division of Educational Laboratories in the Bureau of Research (Office of Education) has not been sufficient to support a major CAI project. The hardware costs and the human resources made such a major investment unlikely over the next several years.

RBS, dedicated to individualizing learning, sees the computer as an actual aid in extending individualized instruction as well as ultimately replacing certain teaching functions. How to invest a minimum amount of money wisely and still obtain high results in both experience and actual instruction for students becomes a real challenge.

Fortunately for RBS the Philadelphia School District made a major commitment to computer assisted instruction. As a direct result of Title I (ESEA) funds 1965-1966, Philadelphia invested approximately $1.2 million in a system designed and installed by the Communications and Electronics Division of the Philco-Ford Corporation.

Already a leader in teaching youngsters about the place of computers in a technological society, Philadelphia suddenly made a quantum leap into CAI.

The advantages for RBS were just too good to pass by. Here in our own backyard was a major city with the type of hardware allowing for experimentation without RBS having to make any investment in hardware rental or purchase.

During the school year 1967-68, the Philco-Ford equipment was ready for use. RBS entered into a joint agreement with the Philadelphia Board of Education during this school year to undertake the development of the IPI mathematics program. The mutual benefits to both parties are many:

-- Basically, RBS pays for the writing and computer team. To date, this has cost the corporation $208,000 over two school years.

-- The school board provides all equipment, office space, and furniture.

-- RBS enjoys the use of forty terminals, eight in each of five school locations.

-- As a result of these site locations, RBS also enjoys the advantages of working with populations from all age spans, including adults. The main driving computer is located in an old converted factory which houses the major innovations taking place in the Philadelphia School District.

-- The system hardware actually contains most of the combined features of the existing rationale described earlier, including micro-mini equipment, television (CRT) display for open and closed circuit, and a computer configuration with the magnitude of an IBM 360/50. Here, then, was a convergence of the best of all worlds.

Where RBS is and where it intends to go depend in large measure on the successes and failures of our work in placing the IPI math program on this Student Audio-Visual Interface (SAVI) system. Internal papers, reports, and a written agreement keep the Board of Education and RBS in a constant state of evaluation. Projections are cautious and subject to change, dependent upon evaluations. Presently, the IPI math is viewed as a diagnostic instrument. The computer makes possible actual instruction and the storage of information on student performance. Some materials will be developed on line, some off line, depending upon the cost factors. Drill and practice, for example, can be done off line at a much lower cost.

All modes of instruction are being considered , including problem solving, simulation, gaming, drill and practice, tutorial instruction, and diagnostic prognosis and instruction.

Approaching the problem of cost feasibility presents a challenge because of the unknowns. The Philco-Ford SAVI system is , for all practical purposes, a prototype system and has not been calculated on a mass production major sale base. Another problem is the question of how teachers are to be employed in the system of CAI. Even given the unknowns, certain factors can be accounted for which demonstrate a feasibility that could indeed be major prior to 1978-1980.

First, the RBS costs are quite modest. For fiscal 1970 the corporation will need to invest approximately $150,000. This investment will yield a return as follows:

-- a continuation of the developmental effort in author writing and programming;

-- research conducted in selected areas;

-- evaluation as a continuing cycle;

-- testing on a variety of populations.

Section H: Education

Chairman: T. F. Rogers, The MITRE Corporation
(for Dr. Ernest L. Boyer)

Dr. Robert Scanlon provided additional background on the development of the individually prescribed instruction program and discussed some of the problems involved in its implementation.

Federal legislation in the early 1960's made possible the creation of the Learning Research and Development Center at the University of Pittsburgh under a mandate to explore the possibilities and methods of individualizing instruction in the Oakleaf Elementary School. Through discussions between the scholars of the university and the teachers and staff of the school, a series of objectives and steps were defined, explored, and developed which lead to the IPI system.

A. Learning Objectives. In an unprecedented and difficult first phase, the educational objectives which the teachers expected to achieve in a given course or subject during a given period of time were defined, further delineated into a host of subsets, and then sequenced on a scale from easiest to hardest. For mathematics alone, 390 reasonable objectives were isolated.

B. Correlation of Objectives and Learning Materials. The second task was to correlate teaching materials and methods with each objective. To do so, textbooks available to the school were analyzed for the purpose of matching each learning segment with an objective. Although 5,000 instructional sets for mathematics and

4,000 for reading were found in the books, about 20 percent of the defined objectives still lacked any available instructional material. Moreover, two other important discoveries were made: (1) most of the approaches and materials suggested for certain subjects in teacher handbooks and guides were in reality not incorporated in the materials used in the schools; and (2) the materials used by the children lacked directions on the assumption that the teacher must be the link between the students and the information.

As a result, the next step in the development was to rewrite the learning materials not only to respond to the defined objectives, but also to encompass a variety of media and to provide opportunities for self-direction by the children. The principle of self-direction had become a central goal of individualized instruction.

C. Monitoring. Another element of the program provided for continual monitoring of progress through a series of three tests (pre-tests, post-tests, curriculum-embedded tests) to: (1) tell the students how they were doing, where they were going, and where they had been; and (2) give the teachers daily information on which to base prescriptions.

This component, coupled with the new role of the teacher, necessitated another major revision in the traditional school organization. Due to the clerical problems in American educational institutions, staff had to be used differently. Non-professionals were used in the system to correct tests and give feedback to the children.

By 1964 the system of individually prescribed instruction outlined was being used in six grades for 240 children in the Oakleaf Elementary School. By 1966 IPI was active in six demonstration schools, and the total has to date risen to 179 schools in 39 states; the anticipation is to serve 200 schools in all 50 states next year.

Problems in the Development of IPI

The principal problems encountered and/or anticipated in the development of an individualized instruction system and particularly in the technological applications involved:

A. Training of School Personnel. The retraining the principals and administrators in the schools is central to getting any large, innovative system successfully installed. Moreover, this task is almost impossible unless the administrators can be led to see beyond the established, structured system.

B. Teaching the Teachers. Although Research for Better Schools has tried to meet the difficult task of teaching teachers to use the IPI system, there is still a great need to work with schools of education to prepare preservice personnel for the processes and problems of individual instruction.

C. Financing. In 1966, when IPI was being used in six schools, materials for mathematics and reading alone cost $46.00 per student. By 1970 this figure had been reduced to $10.00 per student, and the projected IPI cost for mathematics materials has been set at $4.00. However, when compared with the national average of $7.50 per student for all course materials ($1.50 for mathematics), the figures remain exhorbitant.

On the other hand, the further development of CAI, especially in the area of computer testing, may be the real hope within the realm of individualized instruction systems. To presently be effective with IPI in a school of 500 children, there must be a minimum of one teacher-aid to every 100 pupils. Each aid is paid at least $3,000 a year. With CAI the same functions can be performed by one computer for $10.00-15.00 an hour.

D. Differentiating Staff. A restructuring of the present school system is necessary to allow flexibility in the roles and distribution of staff, and in the number of students for which each teacher is responsible.

E. Commercialization. Commercial firms are interested in publishing IPI and CAI materials. They are not concerned with these developments as innovative instructional systems. Furthermore, 22 states have state-adopted textbooks which any interested schools are given free. This not only gives some commercial firms a vested interest in preserving the traditional system, but also it is difficult to convince a state to adopt a total instructional system.

A computer assisted instructional system, which incorporates still technically unrealized capabilities such as testing possibilities and "a voice" to convey information to the many children who still cannot even read, is the real hope, especially for cost reductions. A truly effective technological system of instruction is, however, still 10-15 years away.

Research for Better Schools, Inc., has joined with the MITRE Corporation of McLean, Virginia, to hasten development and expansion of the CAI-IPI program. The two companies have submitted a joint, $7 million proposal to the National Science Foundation, the U. S. Office of Education, the Carnegie Foundation, and the Ford Foundation to fund a four-year program to enlarge current efforts to computerize IPI mathematics, add a voice, and field test. Kenneth Setten, MITRE Corporation, then described the Time-Shared Interactive Computer-Controlled Educational Television (TICCET) system and its background through an audio-visual presentation of the material, TICCET R & D Program.

He then commented on three specific areas relevant to educational technology.

A. The Traditional School System. In the United States there are 50 separate states controlling educational policies; there are about 20,000 separate school systems, each of which is fiercely independent; and there are about 120,000 public schools, each having a fiercely independent principal. Yet, there is an amazing, fundamental uniformity in the schools. They all have the same 12-year system and the same academic year, for example. It thus appears that the alleged independence, especially on the part of the principals, is more intellectual than substantive.

Some of the uniformities are questionable. All teachers report directly to a principal, or manager, who manages an unwieldy system. Consequently, a bureaucracy has been built which stifles performance motivation. Teachers' salaries are based on seniority, not quality.

Although uniformities in the schools are national, thereby making the inherent problems national, the responsibility for change lies with local governments. There are, however, large "innovation gaps" between the technologists working to solve many of these problems and the local officials. The latter are fearful or lack confidence in turning to the technologists for solutions to the common problems. This breakdown in communications and trust is partially due to the technologists who have developed sophisticated methods of presenting briefings to defense and other federal officials, but have not realized that the same methods are not necessarily appropriate on the local level. Also, local officials do not have the money to pay technologists.

B. Implementation of a Technological System of Instruction. In an effort to test the TICCET system, the MITRE Corporation approached the District of Columbia school system, which had access to federally subsidized programs and which appeared interested in innovative approaches. However, in reality it was "harrassed, near chaotic; caught up in frequent changes of superintendents, political pressures, violence, monetary crises, Congressional problems." MITRE was told that it would have to approach the community before anything innovative could be tried in the schools. For reasons not explained, MITRE decided that doing so would be an impossible task.

It then decided to approach a local, white, relatively affluent suburban school system to be a partner in the development program on the belief that, once tested, the technological system could be "rationalized to the point where it would be rugged enough to stand the rigors of the ghetto and ghetto administrators." Although the school approached showed initial interest in the program, after a year of negotiations it was apparent to all involved that this was not a viable approach. Even with the suburban schools' interest in computers as innovators, their access to federal funds, and the stated commitment of the administrators to support technological advances, a bevy of institutional barriers appear when meaningful decisions must be made. This, coupled with the high cost of computers, again hinders implementation of an innovative system.

Responses of Administrators, Staff, and Teachers to the Innovative Programs

A request was made for information on any recorded changes in the attitudes of the students and the teachers in the demonstration schools for IPI who had the opportunity to approach learning in a new and different way.

In response, Dr. Scanlon described the massive, documented changes which have been seen in the attitudes of the teachers. They are more positive, believe themselves more professional, and appear to like their profession better. Among the reasons for these changes are (1) the wealth of instructional materials provided by IPI; (2) supportive, but not threatening clerical assistance; and (3) free planning time, amounting to 20 percent of the day, which the teacher spends away from the children digesting data, diagnosing problems, etc.

A training program has also been developed to assist teachers in understanding and working with the IPI system. Initially the traditional summer institutes for teachers were offered on the assumption that the teachers should be thoroughly trained outside of the school before using IPI in the classroom. However, after two years, feedback from the teachers indicated that, although they enjoyed the summer institutes, they did not believe this to be an efficient mechanism for training. Only a few teachers from a school were able to attend the institutes each summer, which still left a large number "back home" who someone had to train. Local universities were contacted in hopes of establishing more effective and generally accessible training programs. For a variety of reasons, however, this approach also did not prove viable. Thus, it ultimately became apparent that the principal of each school would have to assume the responsibility of training his staff and that the role of Research for Better Schools, Inc., would be to train and support the principals.

The relationship between teacher effectiveness and salary structure was then brought out. Under the present system, the scale of preparation, qualification, respect, and salary for educational personnel descends dramatically between the university professor and the elementary school teacher. Yet, the early school years are possibly the most crucial and influential. The child is at this time introduced to all of the basic elements which will be the foundation of his future educational experience. As noted by Dr. Truman Hunter, Consultant for University Relations for IBM, "We are not putting our money and our mouths together in respect to our educational needs."

In agreement, Dr. Scanlon further pointed out that one of the main problems which must be considered from the societal point of view is that of the student-adult ratio even more than the student-teacher ratio in our schools. If one looks at a scale of the corresponding ratios in American institutions--hospitals with large staffs for a few patients at one end and prisons with small staffs for many prisoners at the other--schools look more like prisons.

Community-School Interaction

The danger that use of IPI and computer systems might lead to further alienation between the teachers and the community was raised. If the teachers are given "a more esoteric knowledge"--that of running the IPI and computers--might they not think of themselves or be thought of as even more set-apart from the "amateur parents" than presently? Also, the issue of the MITRE Corporation not following through on the opportunity to implement their system when faced with having to convince the community was brought up in respect to community-school interaction.

Dr. Scanlon made three points in response. First, his experience has indicated that the real concern of the parents lies with the educational success of their children. Therefore, if IPI and the other innovations can increase this success, the parents' concern should be reduced. Second, teachers, including those working with IPI, are very willing to listen to parents as long as they are not given an ultimatum on exactly what they must do. Finally, in relation to the MITRE Corporation's experience in Washington, he stated that their approach was faulty and caused the subsequent problems. MITRE should have drawn upon the sophistication of the principal and leaders within the school, gotten their support, and let them introduce the idea into the neighborhood. Mr. Stetten added that he believed this particular experience to be unique due to the chaotic conditions in the school system and the school's lack of previous interaction with the community.

The Students and the Educational Innovations

Mr. James Snell, a member of the M.I.T. Science Action Coordinating Committee (SACC), at this time requested to read a statement which opened a new area of broader concern and discussion in the session. First complimenting the speakers on "a beautiful example of problem-solving" in which, by a rational series of steps, they were able to determine how technology could solve the problems of education, Mr. Snell then turned to questioning the basic premises presupposed by this process.

> Let us go back to the original question: What is really wrong with education? You propose to improve the efficiency of education by teaching behavioral responses, as you put it. You propose to do so based on the requirements that kids do what they are told to do by machines. You propose a system in which there are less teachers per student. You propose a system in which there is maximum time efficiency in learning. This is applying technology to do more efficiently the same thing that education has always been supposed to do--to teach more effectively scientific knowledge, math, history, English grammar. And you assume that if kids

> somehow could learn those things efficiently, well and quickly, the problems of education would be solved.

Mr. Snell postulated that these methods only solve part of the educational problem. If one looks at the dissatisfaction--the "feelings of impotence and low self-esteem"--presently rampant in our society, especially among students who are involved in and are the product of the existing educational system, one wonders about the appropriateness of simply making this system more efficient and effective. Rather, as Mr. Snell suggested, there may be a deeper educational problem to be solved.

> How do you teach kids to think originally? How do you teach kids to argue? To write? To wonder? To read critically? Can a machine teach those things? You described math as exhibiting behavior. Math is not exhibiting behavior. It involves creativity and and originality. It is a pursuit. Science is not a collection of facts. It is a pursuit. It is something people are excited about.

In conclusion Mr. Snell requested that concerned corporations and innovators make a commitment to solve "the important problem, which is how do you train people to think for themselves as people and not as automata to these programs." Recognizing that reorienting educational research and development in this direction would be very costly, he restated his belief that the firms' efforts and the funds already committed would be largely futile unless the other part of the educational problem was faced.

Dr. Scanlon responded that, although he had not discussed the goals of IPI in detail, the system is wholly directed toward "self-direction, self-learning, self-appreciation, self-evaluation, and the problem-solving process." On the other hand, Mr. Stetten agreed that the MITRE Corporation has not dealt adequately with this important area on the assumption that the problems of teaching basic skills and facts have to be solved before this other type of learning can take place.

Another participant pointed out that the real discrepancy lies in the nation's rank ordering of priorities and problems. Although one may not agree with this ordering, the professionals and technologists must respond to it as such.

A series of questions, categorized as "zero-order" questions relating to the issue of changes in student attitudes with the innovative programs, were posed:

1. If the IPI and computer programs train children to give certain kinds of responses, can creativity and free types of innovation be fostered?

2. Can you teach one to "wonder," and what role does teaching as an art form and personal contact--neither of which appears to be maintained in these systems--have in this kind of education?

3. Is there any technique for testing whether an educative program has given a child the essential, genuine enthusiasm for learning, the enthusiasm which our present school systems are not providing?

In answering these questions, Dr. Scanlon discussed Research for Better Schools' attempts to measure changes in student attitudes in the demonstration schools. The Rorschach technique has been used to test both the children in the IPI schools and those in the traditional education program. In the former group a significant improvement in the children's attitudes about themselves has been apparent. They are more independent, show increased responsibility for finding their own materials and solving their own problems, ask seven times as many questions, and move around freely and help each other. It thus appears that the learning process has become more personal although a structured, mechanical method had to be used to free the time for personalization.

Dr. Scanlon expanded on the students' attitudes in a ghetto school where discipline is often regarded as the central problem. In a Harrisburg, Pennsylvania, school, 60 percent of the children have no father, 60 percent are eligible for federal support, and almost all live in housing projects. Before the IPI system was started in the school three years ago, there had been 170 police contacts and $5,000 worth of window damage and breakage in one year. Ninety-six percent of the sixth graders and 98 percent of the fifth graders were reading one or more years below grade level. There was total regimentation in the school. Everyone distrusted everyone, and the teachers were afraid of the students.

When IPI was introduced, the radical assumptions which it presupposes--students can be responsible for their own education; a flexible, but effective learning system is possible--were thus totally alien to the situation. Comprehensive retraining of the administrators and staff was necessary. However, now the students are more relaxed, interested, and conscientious about their work. There has been only one police contact during the past year and then a policeman came to thank a child for turning in a loaded revolver which he had found on his way home from school. Last spring 70 percent rather than 96 percent of the sixth graders were reading below grade level. These appear to be very concrete, positive results.

Three other areas were discussed briefly.

1. IPI has been used in an adult education program in the Clark County school district in Nevada. Based on the same materials and the prescription method, adults are able to pick up their materials at a convenient learning center and take them home to work on. Thus, the program is designed to provide the flexibility essential to adult education.

2. The dissemination of new educational systems such as IPI requires a national commitment to the programs from a high level within the educational community. Endorsement from the National Education Association, for example, might be a more effective approach than dealing with individuals, teachers, and local school boards. Existing corporate practice, however, is to focus on the individual school or school system.

3. "Educational responsibility" resides in other institutions in our society besides the schools. Parents and churches have abdicated some of this responsibility and they, as well as the schools, must recognize their critical future role in solving the educational problems of America. Without the joint efforts of all involved, these problems will persist and intensify.

Summary of General Themes

It is clear that technology is applicable to the educational process. Innovative learning systems have been developed, proved effective as teaching devices, and shown promise of considerable future potential. Tested programs, such as IPI, are now available to the schools, and have already become the base for the more extensive, meaningful involvement of technology in education. Yet, some core questions relating more to the purpose than to the processes or programs of technology remain central in the area of education. Further, it appears that the kinds of questions raised in respect to this one field correspond to those raised throughout the Regional Conference regarding the bases of technology in numerous fields.

Technological advances and applications must be coupled with "continuing education" to insure the flexibility essential to understanding the changing nature and requirements of the people. Today some of the deepest questioning is coming from the young. Nonetheless, technologists seem to be responding to the educational problems --the problems and needs of this very group which is demanding change --in a largely traditional context. Should they not begin by questioning the purposes of education rather than questioning the processes of the present system? What should be taught in the schools which will be relevant and meaningful to the child's future environment, to his future goals and satisfaction? Can "genuine learning" be provided simultaneously with the necessary foundation skills and information? By what processes can technology respond to these needs with an improved, efficient, generally accessible system? It is this type of flexibility, this fundamental searching, which many of the participants in the Education Section were requesting.

In a supplementary point, the effects of technological innovations on those involved with them, particularly students and teachers, was considered of special importance. Questions were posed concerning not only the effects of the systems in improving achievement and attitudes, but also the nature of the participants' responses. Are children happy and satisfied with these learning programs? How do the teachers view the systems? Fortunately, the answers in both areas appear to be positive and exciting.

Also essential is the area of technology and the broader societal context in which it does or may function. In education, the majority of which is publicly provided, interaction between school personnel, local officials, and, increasingly, the community is inherent. Relating technological developments and programs in learning to the community and to local officials is, therefore, another core problem which relates to increased participation of the "lay community." Technologists must recognize the need to communicate coherently to all involved segments of the population. More importantly, they must become sensitive to the thoughts and feelings of these groups, and must work with rather than for them in solving the educational crises facing our school systems.

Section I: Innovation

"The Process of Innovation"--Donald A. Schon, President, Organization for Social and Technical Innovation

A vast mismanagement of intellectual resources has occurred over the last decade with respect to social and technological innovations. We have spent intellectual energy on issues of technological invention, research, the development of new social policies and the critique of existing social policy whereas the issues are much more clearly around our incompetence to carry out any program of change at all. The problem, in short, is how are we able to bring any broad-ranging program of institutional change into effect.

We are inadequate at the technology of carrying broad programs into effect. We do not understand this process, although we have myths about it, and it is our failure to understand the process as a working, practical process of change that underlies the difficulties with the policies and programs that we have experienced. Current programs and policies for such things as pollution, environmental control, decentralization of monies and administration, guaranteed income, etc. are likely to fare no better than their predecessors, which were failures. If an idea was in "good currency," it was probably no longer relevant to the problem as the problem now exists. The problem of understanding processes of implementing programs of broad-ranging social change has two major characteristics. First, it is basically a problem of social learning and the design of learning systems. We are perpetually dealing with programs that cannot be "once and for all" solutions to the problems they are designed to attack; this must be the case, because we are living in a situation that can be characterized as a loss of the stable state. As a consequence of this loss of the stable state, there is virtually no established institution that feels adequate to the problems that it now confronts. If we look at federal agencies as a kind of organizational map, each element of which corresponds to some problem, the problems have tended to shift out from under the map. Consequently, it is possible to look at federal agencies as a series of memorials to old problems. But the practical consequence of the loss of the stable state is that any programmatic solution to a problem has got to see itself as a learning system capable of shifting over time and cannot get stuck with an organizational, institutional or programmatic definition, which was pertinent to the state of affairs at the time the program was invented.

The second characteristic of the problem of understanding the processes of implementing programs of broad-ranging social change is that all social organizations have a resistance to change that might be described as "dynamic conservatism"--that is, a tendency to fight to remain the same. And, all social organizations have a technological plenum; that is to say, there is never an absence of technology or a vacuum into which new technology might move. There is always an existing technology and a social system tied to the existing technology, and a social system will fight to preserve itself, and a change in the technology will be resisted just insofar as it threatens it. Therefore, the solution to the problem must contain elements of politics, power and leverage. In fact, most changes of this kind in our society in the last thirty years have been effected either through a form of insurgency or invasion and almost never internally.

An obstacle to the development of approaches to innovation, to social learning, that would be more effective than that which we have thus far experienced is the existence of a kind of rational mythology about how we do it. This rational mythology is built into governmental programs of change. For example, we believe a program represents a "once and for all" solution to a problem, and that there is a one-to-one correspondence between the problem and its solution. We believe in the notion of public experiment. But, experiment presumes Mill's method of difference. It presumes you can hold all variables constant except one, and that you can stimulate that one and observe the effect of that stimulation on the rest of the system. In the real world situation there is no possible experiment in the scientific sense of that term. The rational mythology presumes that it is possible to evaluate what you have done and learn on the basis of the evaluation. In the real world situation this, in fact, almost never happens. Evaluations are almost never read--when they are read, they tend to be found inappropriate to the next situation, which is discovered to have changed. Political considerations emerge that are powerful enough to govern the formation of the next program and the like. A final element of the mythology is that you can move from pilot programs to large-scale programs. You start small and you can move big. The notion of a straightforward or mechanical spreading of the learning from a small pilot to a large scale national program is vastly oversimplified. Furthermore, there are certain scale effects which can make it true that if we perform below scale in a pilot we will fail, not because the pilot is wrong, but because we are not at scale. Likewise, we are by no means assured that if it succeeds, we can scale it upward effectively.

If we are to successfully develop processes of innovation of broad-ranging social programs, we need to be concerned with them in a somewhat different way than we have in the past. We must conceive of them as learning systems in themselves, capable of transforming themselves for the situations in which they function and of growing organically from small beginnings.

There are certain themes to these programs that are quite critically important. One of them is the theme of networks and network management. If the organizational map for a given problem is inappropriate to the problem, then a solution to the problem must take the form of the management of a very complex institutional network. And, network management becomes one of the principal features of that effort. If the organizational map is out of kilter with respect to the problem, the brokerage role becomes central. People who operate in the interstices, the spaces between organizational units, become critical. The third element is that shadow systems and the staging of shadow systems become critical. A fourth element is that we must find ways to manage programs at a manageable scale and work the transition from manageable scale to the scale at which impact is desired.

We must find ways to undertake in every public sector area, around every piece of public sector technology, a form of program development which is, by way of being, a learning system which can change itself over time; where the distinction between research and pilot program activity cannot be sharply made; and where the monitoring and evaluation process is built intimately into that system. Nothing short of this will be effective in responding to the problems of program implementation that we now face in every broad program area.

Section I: Innovation

"The Management of Technological Innovation"--Albert J. Kelley, Dean of the School of Management, Boston College

Most people think of the space program only in terms of the technological triumph that it was; they overlook the matter of its organizational and managerial skill. Actually, it is this organizational and managerial skill that may go down in history as one of the greatest accomplishments of the space program. It was not simply new techniques such as computer management, PERT and systems analysis, but rather the organizational abilities of bringing together people and resources that made the program a success.

Much credit should be given to people like House Majority Leader John McCormack and then Senate Majority Leader Lyndon B. Johnson, who understood some of the points brought out by Dr. Schon about the process of innovation. They conceived the concept of a single government agency to handle the entire space program. The program could have been fractionated, spread over existing agencies, subjected to the forces of dynamic conservatism, etc.--spread out over the organizational map. Instead, it was made a conglomerate of several aspects of other agencies. In many ways it operated as a planning and management agency, using the leverage of manipulating a work force of 400,000 people in the private sector with its own 20,000-man work force.

NASA employed good management techniques, such as the leadership concept of find the right man for the job, give him the tools, the authority and back him to the hilt. Another concept is that of using committees where they are appropriate, but using them as advisors, not getting them into the line management. NASA also refined the concept of the project manager, which was a very unnatural management concept, because it violates every rule of organization hierarchy.

Within the framework of project management the concept of systems engineering was used. This means breaking down the job or problem into manageable pieces and then putting them back together again with the result being a final product. NASA also developed a rather unique relationship between the government and industry and universities. Ninety-five percent of the space program (both people-wise and money-wise) was accomplished by industry and universities. Great pains were taken to prevent the development of an adversary relationship between the two parties. A team atmosphere was developed. Along with this was a concern with people. The people involved were visible. Also, the concept of in-depth management was developed.

One of the most important aspects of the NASA model, as it applies to this meeting, was the working relationship that was developed in a political and public environment--nowhere else in history has a technology program been so exposed to public and congressional scrutiny. There was a very definite, conscious attempt to explain this program to Congress and to explain it to the layman.

The Apollo project had a definite goal. This was done by President Kennedy when he went to the Congress for authorization.

Of course, a lot of hard work was done before he put his neck on the line. For example, before NASA made a commitment to President Kennedy, the entire program was planned and estimated. The program was put through a PERT program five times--and the task was something like build a Saturn IV, or build a Cape Kennedy. These are the reasons NASA was able to accomplish what it said it would do, namely to put a man on the moon within the decade. There was no magic about it. It was just a lot of hard, dedicated work. The questions, "What are we going to do, when are we going to do it and how much is it going to cost," were asked and answered constantly.

It is interesting to note that at the time Project Apollo was initially put together, the plan was to go to the moon in a different manner than was actually achieved. Thus, the plan was adaptable to a changing environment, that environment being the aggregate knowledge of space exploration. So, the method was changed, but the time and the price remained the same. The lesson here is that in a program where the big inputs are manpower and brains, changes can be made along the way, and the original targets can still be met.

The Apollo program was a definable engineering problem. As such, it was not as difficult as some of the softer sociological problems we face today. Yet, if we want to bring the awesome resources of brains and manpower that made up the space program to bear on the sociological problems, we must give serious consideration to the management of those resources.

If sociological programs that utilize science and technology are to be supported by money and by non-technical decision-makers, who after all make the final decisions, these programs must be thought out. They must be explained. They must make sense in the language and reference of the layman. They must not be overly constrained; that is, they must leave some room for maneuvering for the unexpected.

This is what was done in Project Apollo. It has been a success. If this is done for our future national programs, perhaps they will be as successful in fulfilling their goals.

Section I: Innovation

Chairman: Albert J. Kelley, Dean of the School of Management, Boston College

The discussion centered on the "responsibility" of an innovator working within the public domain.

Is he responsible totally to the client (the person who brings him a definition of the problem), or is he responsible to the consumer, who is ultimately going to receive that solution and who may construe the problem quite a bit differently than the client?

The people for whom the social programs are aimed must be involved in the formation of those programs; otherwise, the people will not accept the solutions that science and technology come up with. The people must have a feeling of citizenship, of participation.

We should give up the idea, which is a myth anyway, that there is such a thing as a good plan. There may be such a thing as a good incremental planning process, which assumes that any given plan is going to be inadequate to the complexities that it has to resolve, and that it is going to have to be modified in the process of presenting it to people who are going to be affected ultimately by the outcome of that plan. Another myth that should be given up is that of a definable market "out there," and the belief that if you can define the market, then you can generate, even in the absence of constant inputs from that market, a good plan for that market.

In private sector a project has to be shown to be technically and economically feasible. But, in the public domain the same project must be shown to be technically, economically, sociologically and politically feasible.

Can people be trained to develop the adaptive behavior required in Dr. Schon's presentation, for greater societal flexibility? The problems are so complex that expertise in any one area is inadequate. There appears to be no other vehicle in our society at the moment to provide such training, except apprenticeship. Formal education seems to be irrelevant to the needs of the persons involved in finding solutions to these complex problems.

Section J: Opportunities for State Science Action

"Opportunities for State Science Actions"--T. G. Fox, Governor's Science Advisor, Commonwealth of Pennsylvania

All of us are concerned about how we use science and the resources of universities, industry, and government to solve some of the important problems of this last third of the twentieth century.

The basic problem of the middle third of this century was science and defense. Now the problem is the interaction of science and society. I refer to problems that we live with every day: what kind of housing we have; what kind of transportation we have; what kind of cities, environment, health services, and police protection. These problems are quite different in content and style from those of space, atomic energy, and military development. We have to find ways to use our resources with new partnerships between industry and universities and government--federal, state, and local--to tackle these new problems effectively.

The question is, of course, what kind of new partnerships should we fashion between universities and government or universities and industry or federal government and state governments? What are the new programs, new partnerships, new arrangements, new roles that we're trying to bring about? And,"How do you bring it off?" How do we get it to happen?

"THE NEW FEDERALISM"--A STRATEGY FOR SCIENCE FOR SOCIETY IN THE SEVENTIES

Purpose

To consider means for coordinating federal and state science programs in the 70's to insure effective utilization of technology to meet critical urban and human needs throughout the United States.

Rationale

Innovative technological developments in housing, health, transportation, environment, and education require acceptance and adaptation of new domestic technology at the "grass-roots" level.

The magnitude and nature of the task require both federal and regional leadership in marshaling the resources--political, scientific, academic, industrial, and social--which must be committed if our nationwide urban needs are to be met.

Unlike the specialized needs of the recent era of national science (as in defense and space technology), but akin to the transfer of agricultural and medical science to practice in the last century, a nationally inspired and coordinated but regionally diversified program with strong local participation is essential.

The Challenges

President Nixon's "New Federalism" and the development of new domestic technology require that state governments develop strength in mobilizing innovative technology-generating resources.

Dr. DuBridge's call for new centers in interdisciplinary applied science identifies an important route to new concepts and broadly trained professionals.

The magnitude of the task requires the use of our great private resources in close partnership with the local government and the applied science centers.

The Question

What can state governments do and what can federal agencies do in concert that contributes more to these goals than the sum of independent uncoordinated efforts?

Speaking broadly on the application of science, the U. S. experience in this century may, perhaps, be categorized under three main headings:

1st Period--Science for Industry

In the first third of the century we learned how to mount organized research and development undertakings in industry to speed technological progress in selected areas. The universities grew and adapted to support this effort through basic research and the training of professional scientists and engineers.

2nd Period--Science for Defense

In the middle third of the century we learned how to mount massive national undertakings to promote technological progress in selected areas vital to our national defense. Congress, the federal agencies, our university communities, and the new aerospace industry which had to be established learned to work together to supply the source of basic science and developmental apparatus on a systems scale required to do this job effectively.

3rd Period--Science for Society

In the last third of this century our nation is faced with critical urban and environmental problems whose ingredients and solutions involve both technological and social factors. We are challenged to learn how to utilize our knowledge and resources effectively to insure certain and continuing technological and conceptual progress toward these. There needs to be a revival of engineering scholarship in its broadest sense with strong participation by state and local governments and industry in new partnerships as yet undefined.

THE "NEW FEDERALISM" AND THE DOMESTIC TECHNOLOGY OF THE 70's

Challenges

The key practical questions appear to be:

-- How do we generate a sophisticated policy on the utilization of science and technology in the individual states or, when appropriate, in their regional groupings?

-- How can we alert our universities and other innovative technology-generating centers to today's problems and utilize present resources in new ways to provide centers of excellence in applied interdisciplinary research on today's domestic problems? How can we insure that this is done in close interface with those ultimately responsible for the choice, adaptation, and installation of the end product?

-- How can we mobilize the private and industrial resources regionally and nationally to meet the challenge of improving and preserving the physical plant and environment of communities throughout America?

-- How can the federal government stimulate and support the necessary locally oriented political-academic-industrial apparatus in individual states or regional associations?

We believe it the responsibility of the NSF and of the academic scientific and engineering community:

-- To make it unequivocally clear that the goal of responsible use of knowledge to serve society is at least as challenging and important as that of the generation of knowledge.

-- To encourage interdisciplinary academic engineering oriented toward real problems in interface with governmental and industrial authorities, preferably local, responsible for practical programs.

To meet its responsibilities to other governmental agencies and to the several states, we believe NSF should:

-- promote the information of high level science policy advisory groups in individual states (or regions);

-- through matching funding, join with individual states in establishing interdisciplinary applied research centers.

"NEW FEDERALISM" AND THE DOMESTIC TECHNOLOGY OF THE 70's

Guiding Concepts

Clearly it is not merely desirable but critical that the national strategy of the 70's, designed to use the knowledge and resources of our post-industrial age to raise the quality of life for all Americans, be based on a dedicated federal-state alliance. Federal-state policies and programs relevant to the utilization of science in the service of society must strongly reinforce each other, in diverse regions and circumstances.

Patently, this requires close and continuing communication and sensitive coordination, beginning now. A partnership with a responsible role for both the state and federal governments, is surely the essence of "New Federalism."

Obviously, this requires sophistication and insight, at both ends of the exchange. Means must be found to promote sophistication and sensitive understandings where they are in short supply.

Today many well-staffed centers of research and development exist and means for production of products appear unlimited. The resources of the innovative genius and industrial insight of this nation must be harnessed in new ways if the high domestic goals of 70's are to be realized.

What is missing are the concepts, the motivated professionals, and the organizational concepts. We need sufficient numbers of our best young (and older) people, prepared with appropriate background, belief in the goals and concepts, and motivated to dedicate themselves to the new task. Our universities'traditional role in our society, and opportunity, is to provide these in sufficient measure. Any strategy must surely be based on university leadership in promoting not less science but more application of science and engineering to today's special problems, not less depth in specialties for some, but more breadth for others; not less dedication to the discovery of new knowledge, but surely, as the university community grows, more dedication of larger numbers to the utilization of knowledge to serve man.

Clearly, applied research concepts directed at the physical structure of our communities and public facilities cannot be generated in isolation from those in authority who are responsible to their communities, nor removed from those with practical knowledge and responsibility for ultimate delivery of technology. Centers of excellence in conceptual pioneering applied research in our universities are essential, but only in strong communication and coupling with those responsible for acceptance, adaptation, and installation of the end product.

In short, industry must respond to the opportunity to provide efficiently the technology to rebuild our cities, to preserve the environment, to provide needed health services, to make viable the communities in which they are located and limit or elevate the quantity of life characteristic of our technically advanced society.

States must be encouraged to develop strength and sophistication in marshaling their innovative technology-generating resources.

Federal agencies must initiate and coordinate the national effort while encouraging initiative and diversity in the individual states and regions.

Mechanisms for strong interaction of federal-state policies and programs in ongoing fashion are essential in interdisciplinary engineering and applied science on public problems, with a broad base, and a strong interaction with government and industry must be fostered.

Section J: Opportunities for State Science Action

Chairman: James R. Killian, Jr., Chairman of the Corporation,
Massachusetts Institute of Technology

Dr. Thomas Fox expanded on his presentation of the process of innovation in the growth of institutions.

Innovation produces new concepts and technology to meet new human needs and wants. It involves inputs from industry, the universities and the community. The original idea develops until it is eventually put to use, and each of these inputs has a varying amount of influence on the idea:

	New Services to Humans		
	Relative Role of		
Stages of Innovation	University	Community	Industry
1. Definition of Problems	↓	↓	↓
2. Innovation, Conceptual Solution			
3. Explore and Develop Basic Solutions			
4. Feasibility, Demonstration			
5. Development			
6. Installation			
7. Use			
	decreases	increases	increases

In previous years, the "community" (represented by the federal government) was instrumental in supporting universities and industry in their efforts to produce technical innovations in physical areas such as in defense, nuclear energy, and space. Today, however, industry is not meeting the country's needs in transportation, housing, environmental problems.

University research in these fields often does not take into account the social and political factors which affect their development. In approaching today's social problems--pollution, education, housing, transportation--the country needs leadership from the federal government to encourage research in industry and the universities. The role of the community--state and local governments--will become increasingly important.

Innovations in these socially oriented fields will affect the United States on the local, small community level. As a result, commitments on the state and local levels will be essential in introducing these innovations.

Examples of directions taken in their communities to promote action in domestic fields were then described by several participants.

Mr. Melvin Zisfein, the Franklin Institute, described IDRES and its research efforts, which are directed at improving the Pennsylvania region's river system. This research is guided by inputs from Pennsylvania towns and cities. This advisory committee stimulates the primarily academic staff of IDRES to pursue new directions and to work towards social goals which the committee defines.

Dr. Fox suggested that universities look to the model of land-grant colleges with agriculture extension programs as a means of enabling universities to contribute to science action in their local communities. Under the agricultural extension program, extension specialists in the field work closely with researchers from universities. In this manner, technicians from Lehigh, Temple and other universities cooperate with the Franklin Institute and area oceanographers under the IDRES program.

Another example of community contribution to science action is in the form of state scientific advisory committees. State advisory committees, which promote scientific advancements, can act as influence groups on the state legislatures; committees can influence the state decision-makers in determining their priorities for spending. Members of the Workshop session represented such committees in New York, Connecticut, Massachusetts and Pennsylvania.

Dr. Detlev Bronk mentioned the President's Science Advisory Committee. He said that this committee's effectiveness was due in large part to the friends its members had developed in the United States legislature. He stressed the value of personal associations to strengthen an advisory committee's influence in a state or region.

In Massachusetts, a Science Advisory Committee has been unsuccessful due to lack of such support in the legislature. The Massachusetts committee was established five years ago by Governor John Volpe in connection with the Department of Commerce. However, since that time, funding for the committee has been minimal. The committee members have received no direction from the state legislature to define their role as science advisors. The Massachusetts scientific community has not contributed either; they are concerned with their own projects and have not sensed an interest in state funded research from the state legislature.

Dr. Killian suggested that the governor's support would strengthen the Science Advisory Committee. In Pennsylvania, the governors see the committee as central in their administration. Pennsylvania state cabinet members work closely with the Advisory committee.

Funding for programs and research rests on state support. In New York State, funding from the State Science and Technology Foundation fluctuated from $500,000, to $1 million and then back to $600,000. Although state committees and regional organizations can supply the "interfacing" for communications among government, industry and universities, the federal government must provide leadership and financial backing for science research.

Section K: System Research and Management for State and Local Systems

"Slippery Water: A Demonstrated Advance in Fire-Fighting Technology"*--Edward H. Blum, The New York City RAND Institute

The "Slippery Water" Project

RAND's work with the Fire Department of the City of New York (FDNY) is in part designed to help develop new technology to enhance the protection that the Fire Department can provide. The objectives of this research are to:

-- Find new technology that shows promise of enhancing the Department's over-all effectiveness

-- Analyze this technology to assess its relevance to Departmental needs and to devise means of applying it effectively.

-- Stimulate and, where possible, accelerate development and application of especially promising items.

One product of this work, for which all the objectives have been fulfilled, is "slippery water"--water containing minute quantities of a special chemical that enables it to flow with far less resistance, and thus with much greater speed, than had previously been possible. Only a laboratory curiosity as late as 1968, slippery water is now in the last stages of a development program aimed at bringing it into routine Fire Department practice. Its feasibility and prospective use have now been demonstrated convincingly--in Fire Department tests and in public.

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*Condensed from a larger paper available from the author.

In the Fall of 1968 RAND's staff suggested to the FDNY that a friction-reducing additive might greatly increase the pumping capacity of present equipment. Systems studies conducted by the Department had outlined the advantages of maneuverability in 1-1/2" hose, but also indicated the need for the water delivery capability of the 2-1/2" hose. By increasing flows through the 1-1/2" hose, slippery water offered a potential for combining these advantages. When the Department agreed to the importance of the development, Dr. Edward H. Blum, the RAND project leader and a chemical engineer, contacted people in the research and development division of Union Carbide's chemicals and plastics division. Experimental work on the use of friction-reducing additives had been performed in the 1950's, but these efforts had been limited. As late as December 1968, the grade of Polyox which is most desirable in friction reduction application was very scarce and available only in very small amounts.

Though Carbide was pessimistic, October meetings revealed that a plant under construction would assure a sizeable supply of Polyox early in 1969. However, the technical obstacles of putting Polyox into solution in quantities adequate for fire fighting application had not been solved.

FDNY's continued interest renewed Carbide's interest in using Polyox in fire fighting, and, for the first time, all parties saw possible ways to solve the practical problems of slippery water. Carbide agreed to a small effort to pursue the experiment further.

Progress continued through December. In the third week of January, Carbide assembled the necessary test equipment at the Welfare Island training site. First results were disappointing because only hydrant pressure and a short length of hose was used; however, on the following day, regular pumping pressures and a longer stretch of hose were used. Flow was increased by 40-60 percent. On the 6th of February, these results were repeated in a demonstration. In this demonstration, with eight lengths of 1-1/2" hose and a pumping pressure of 200 psi, flows increased from roughly 120-130 gpm to roughly 200 gpm with the addition of Polyox at 30 parts per million. In addition, the differences in the throw of the water and compact shape of the stream were clearly visible.

Following a public demonstration of slippery water in May 1969, the slippery water development program progressed along the following lines:

-- In the summer of 1969, the Fire Department and Union Carbide, with RAND assistance, carried out extensive series of tests and experiments. Tested were the individual and combined effects of different hoses, nozzles, injection methods, and additive concentrations.

These tests showed that, when properly mixed and injected, concentrated Polyox solutions consistently yielded slippery water with less than 35 percent the turbulent friction of ordinary water.

-- Using the injection technology refined from the tests, a regular pumper was taken from the line and equipped as a first-generation prototype. The pumper, with its special equipment, was tested and extensively and repeatedly modified on the basis of the tests to improve its performance. After the basic injection system was made to function smoothly and reliably, automatic flow regulators and controls were added to it, to ensure that the additive concentration in the hose stream would be maintained near its optimum value.

-- The development team prepared operating procedures for the use of slippery water in fire operations. These were then translated into Department regulations to guide the use of slippery water in fire fighting. Men were selected to run the operating pilot program, and practice and training sessions were carried out for several weeks.

-- The prototype pumper was activated in October as a special section on one of the most active engine companies in the City.

-- Beginning in the summer, Union Carbide intensified its research on a more concentrated form of Polyox to replace the water solution used in the first-generation prototype. The research resulted in a slurry, which permits the same amount of Polyox as carried by the prototype to be carried in one-tenth the volume.

Use of the slurry will permit reserve supplies to be carried on board, too. Resupply will thus become a very minor problem, and logistics will be greatly simplified.

-- Despite early tests, which indicated that Polyox solutions might degrade when stored for long periods, the concentrated additive solutions used on Engine 283-FRA held up very well. In fact, during the first several weeks, the useable additive concentration in the storage tank increased, due to continued, slow solvation.

-- Following some of the initial tests, top-ranking fire officers estimated that using slippery water would be equivalent, in easing the workload on the men, to putting one additional man on each engine company. Using slippery water on all the more than 225 engine companies in the City, at all fires, would cost roughly $100,000 per year. The implied gain in effectiveness, on the other hand, would be roughly $20,000,000 per year, or two hundred times the cost.

Institutional Relationships

RAND has served as initiator, catalyst, and continuing technical and administrative liaison--a high-powered technological broker, as it were, in the development of slippery water. RAND staff helped the Fire Department identify the solution to one of its central operating problems, and helped the high-technology company develop working systems to put the solution into practice. Both the Fire Department and the company agree that the development would not have come about without this intervention. It may be useful to explore briefly why.

First, as numerous students of bureaucracy have noted, line agencies are ill-equipped in outlook, skills, and organization to undertake novel or significant technological change.* They are especially ill-equipped to undertake efforts that involve more than minimal technological uncertainty and risk. The rewards for success within the organization are too small, and the price of failure disproportionately high. Moreover, even in those rare government line organizations where innovation is prized, it is not clear that technological research and development are legitimate activities to which to commit scarce manpower and funds. Diverting men and money from "standard" activities may raise both political and bureaucratic hackles, and spending on "untested" devices without competitive bidding may run afoul of purchasing regulations.

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*See, for example, R. W. Archibald and R. B. Hoffman, "Introducing Technological Change in a Bureaucratic Structure," The RAND Corporation, P.-4025, February 1969.

Even when these obstacles are overcome, line agencies are often quite uncomfortable dealing with unstructured problems or engaging in unstructured relations with actual or potential contractors. Many have been badly burned before by buying or using "unproved" products, accepted due to attractive sales efforts, or by entering into relations whose eventual outcome could not be clearly explicated. And, of course, few line agencies, particularly at the state and local levels, have either the funds or the technically skilled personnel required to engage actively in technological development.

On the industrial side, the obstacles are different, but no less bothersome. Top-flight chemical companies, for example, have too many potential products, and too many existing markets for current products, to be able to devote scarce technical manpower to developing a small, uncertain market for uncertain customers. Especially where significant technological problems must be solved to put the product into practice, and where sizeable investment may be required before any returns will be visible, the high-technology manager is likely to be reluctant to invest.

Moreover, it is difficult for most companies to know what markets they may be able to cultivate among government agencies. Even those who deal often with government tend to depend heavily on the agency's knowing specifically what it wants and issuing an informative request for proposal or request for bids. Most of those who do not often deal with government intensely dislike the red tape and slow payment that government orders usually involve. And few companies are sufficiently well structured or equipped to handle informal relations with government agencies that do not involve contracts, sales, or obvious public relations.

As an intermediate organization that was able to gain the confidence of both the agency and the company, and had the skills to act effectively in the needed technical and administrative roles, RAND was thus able to help bring about a major breakthrough. By having worked closely with the Fire Department for several months before the initial meetings between the Department and Union Carbide, RAND staff were able to identify clearly how the development would help the City and how the development program would have to be carried out to ensure its success.

Our strategy for the program, for example, included:

-- Ensuring that, early in the program, the product was demonstrated under conditions that showed its worth but did not oversell it.

-- Making certain that both the company and the agency realized the need for parallel development paths, and were willing to pursue them, despite the added effort. Parallel development was needed here to minimize the risks inherent in a technological development of this type, and to ensure that at least some working system would be achieved without forever foreclosing the chance of achieving a superior system.

-- With parallel development, then, we managed the program to ensure that it did, indeed, enlarge options; show progress while working on longer-range solutions; keep initial resource commitments relatively small until feasibility could be established clearly; develop capabilities and interests within the Department to match those in the company; help stimulate development of appropriate resources and policies in the company; keep testing programs foremost in mind each time a major step was taken; keep small the number of technological leaps attempted at any one time; and keep up a working style that kept major figures in both the agency and the company satisfied with their roles and the joint progress.

Section K: System Research and Management for State and Local Systems

"Systems Research and Management for State and Local Programs"--
Harrison S. Campbell, Vice-President, The New York City RAND Institute

I. INTRODUCTION

Systems analysis, and its related methods and offshoots, has seen its fullest development in defense work. Recently we have seen serious attempts to establish similar in-depth research on urban problems and "civilian" governmental affairs. In part this is a process of adapting an existing capability to these different and new substantive areas, and in part it is a matter of learning and applying new skills in urban analysis--not strongly represented in the defense-related research firms--to policy questions. This paper reviews some of the experiences of the RAND Corporation in transferring its approach to problems, its methods, and its style to work on problems of New York, in the New York City RAND Institute, and other civil or non-defense areas.

Planning and executing research is a complex process of interaction between the prospective client and the prospective research staff. Work areas that are seen as worthwhile to both sides have to be found, these have to match the skills of the research team, and machinery for coordinating, adjusting the detailed goals, and communicating and using the results must be established. There is also the important question of impact. Scarce public funds are involved. It is not sufficient that urban problem research be challenging in an academic sense, or relevant to public questions, or even that financial underwriting can be found. Ultimately, the resources allocated to the job have to be justified by the quality and scope of the impact that is likely to result.

II. URBAN SYSTEMS RESEARCH--TERMS OF REFERENCE

By "systems analysis," we mean systematic, policy-related studies, conducted on a comprehensive scale, using advanced analytical methods where appropriate. Studies of this general type attempt to focus on somebody's policy choices (explicit or implicit). They state their own assumptions carefully and even prominently. They should not end with the delivery of a report; rather, reaction to feedback from the agency and concern with implementation should be part of the job.

It is worth noting that studies in this general category vary widely in subject and scope. A "system" is defined relative to the purpose at hand. Some specific examples may be helpful; the following are taken from our program, but the work of other organizations would afford other useful and contrasting examples.

-- One study is concerned with the "response" policy of fire departments: given the number and location of pumper and ladder companies, how many of each should be dispatched in response to an alarm, should this response be adaptive to circumstances (as when some of the companies are out on other calls), and what rules should govern temporary relocation of companies into areas experiencing heavy demands? This kind of study lends itself to relatively precise definition and the use of mathematical models.

-- Our work on housing in New York has addressed a different policy level, bearing ultimately on the City's role in the market for housing.[*] The system involved is large and loosely coupled. It affects citizens in their several roles of renters, landlords, and taxpayers, whose actions are hardly subject to management (but whose reactions must be taken account of). The work dealt extensively with demographic factors, with the cost of providing housing, with the characteristics of the housing stock, and with programs for managing and sustaining that stock.

-- In a recently completed study of air transportation for the New York region,[**] a major part of the work involved comparing some alternative future air transportation systems as ways of expanding the region's capacity. This study involved surveying future technology and considering operational aspects, but its policy thrust is more toward choices among alternative future systems, and on the type and location of facilities and airports--in short, it falls into the planning domain.

-- Studies of new technology find their way into systems analysis and policy research. Examples in our case are slippery water,[***] and work on the feasibility of early fire detection and warning. In both cases, the role of the technical development in the context of the larger system is an important aspect of the work.

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[*] Lowry, I. S., Rental Housing in New York City, Vol. I, Confronting the Crisis, The New York City RAND Institute, RM-6190-NYC, February 1970.

[**] Campbell, H. S., et al., Alternative Strategies for Development of Air Transportation in the New York Region, 1970-1980, The RAND Corporation, RM-5815-PA, August 1969.

[***] Discussed in Section X of this Conference.

-- Supporting and specialized studies should not be overlooked. These studies build research capital as well as provide information on a particular subject to policy makers. Numerous examples come to mind: an investigation of regional migration, aimed at clarifying the character of the changes occurring in the urban population; collection and analysis of information describing the inmate population in the City's detention and correctional facilities; a survey of the utilization of outpatient services provided by New York's licensed psychiatric clinics; or the analysis of the geographic and temporal patterns of calls for police service or fire incidence.

It is clear that the capability for organizing and conducting such studies is difficult to develop and sustain. Furthermore, success or the lack of it is not always easy to assess for any particular proposal. Frequently the objective is to improve an ongoing organization, and controlled experiments leading to an unambiguous demonstration of results are impractical. Sometimes the results are clear-cut, sometimes not. The problems this creates for managers, in both the consuming and producing ends, are obvious.

III. THE PROCESS OF ESTABLISHING A CAPABILITY FOR URBAN SYSTEMS RESEARCH

In working with the City of New York, and with other new agencies or clients, the important characteristic of starting up seemed initially to be the transferring or transplanting of basic methods from an area where they were established tools--the whole defense analysis area--to new ones. But it has not been a pure transplanting process. A large research company has occasion to underwrite quite a variety of studies, and some individuals had already been exposed to the new areas of research or had previous useful experience elsewhere. Some skills were recruited particularly for the new areas.

But basically, when we approached the concerns of state and local programs, we brought generalized methods, while lacking depth in the substance of these new areas. Particularly, we lacked a sense of the outstanding issues, immediate or long-term, in the context we were to address.

The first requirement is to locate the general areas where the problems seem to match capabilities, involving at first tentative, but quickly firm, commitments to potential researchers on the one side and various parts of the organization of the client-to-be on the other. A good match is easy to perceive after the fact--the team learns as it goes and becomes useful by the end of its initial allowance of time.

Such a description of learning on the job may not seem particularly unusual and might be regarded as unfortunately commonplace in the consulting world. The difference is that we are not discussing here the usual sorts of consulting services arrangements. This kind of problem-solving involves research, and it is always experimental to a degree. And even research by highly experienced groups will run some risk of yielding an uninteresting outcome in any particular case.

This brings us to the observation that some learning on the part of the customer, on how to be a good consumer of research, is also important for a successful relationship. The most obvious reason is that each potential project possesses its own costs, risks, and payoff possibilities. The assessment of these elements is clearly a difficult job at best. A "good consumer" of research develops his own capability for appreciation of, and even performance of, studies so as to understand the significance of the work as it develops and make the most of its possibilities. Teamwork between the in-house group and the outside studiers can be very productive.

However, it is too much to expect the governmental circles with whom you are working to behave as though they had an explicit charter to sponsor and learn to assimilate urban systems research. They have many other concerns competing for their attention and are understandably more interested in the prospect of near-term help than in the somewhat abstract objective of establishing a new species of technology for problem-solving. It is essential that someone highly placed in the sponsoring organization have an overall, long-range view of the program as it develops, but it is unrealistic to expect every group with which working relations are established to possess this same outlook.

Assuming that the research team in question has something to contribute and can assemble itself with a staff of the proper composition in a reasonable time, the main ingredients for getting underway are the following:

-- Warm interest at the top in the basic idea.

-- Financial support, sufficient to provide for an overall program of some scope and for a number of projects of differing type, size, and substantive areas, including the willingness to offer a grace period appropriate for the circumstances, during which major results are not expected.

-- It is most helpful if interest in analysis within the agencies or departments exists at higher levels. In New York there has been an effort to create a program budgeting system. Our own role in developing this area was modest, but the effort as a whole did encourage analytic beginnings in the various agencies.

-- It is also most helpful to find capable, active "opposite numbers" at the working level.

IV. CONCLUDING COMMENTS AND SOME QUESTIONS

In the preceding pages we have discussed rather briefly the task of establishing systems analysis and policy research, as a contributor to new, important areas of concern, different from traditional preoccupations. This was considered in the light of the New York City RAND Institute's--and the RAND Corporation's--particular experiences and opportunities.[*] These experiences and related considerations do serve to raise a number of questions, however, that deserve thought and discussion.

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[*] For a fuller discussion, see Szanton, P. L., Working with a City Government, RM-6236, The New York City RAND Institute, January 1970.

-- What kind of institutions are best adaptable to research on urban and regional matters, particularly where the sponsors are states or cities? The obvious candidates include the following:

Non-profit policy research companies,* more or less dedicated to one or a small set of clients.

Profit-making research contractors and consultants.

Universities.

In-house research groups.

Some mixtures will result in practice, and, based on our own experiences, there would appear to be significant roles for each of these types of activity. Nor are these pure types, exactly; the research companies themselves make extensive use of university talent and look to the universities for recruits.

-- Where does financial sponsorship come from? A fairly large governmental unit with a large budget may see itself as a sponsor as well as a consumer of studies, but small cities or state governments cannot. Joint sponsorship by an association of cities or states suggests itself, though that arrangement has a major disadvantage: the customer most apt to demand and use good research is one that is paying for it and overseeing it directly. Federally provided funds and foundation grants are playing a role.

A related question is how to arrange for the support of basic or long-range research. The local or state governmental unit will not typically view the building of new research capital as its responsibility, but it is important, both for its own sake and to help attract and keep a good staff. Federal and foundation assistance will undoubtedly contribute in that direction.

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*For a discussion of the future fole of federally-funded companies, see Coddington, D.C., and J.G. Milliken, "Future of Federal Contract Research Centers," The Harvard Business Review, March-April 1970.

-- Management of research remains a difficult area, especially from the consumer's point of view. No ready substitute suggests itself for a combination of experience and internal capability for formulating and evaluating plans and ongoing research. Implementation of results relates closely to the management of the research effort as such. Dealing with a highly nonstandard commodity possessing a long production time, subject to real uncertainty as to its ultimate usefulness, and undertaken in a world where topical issues can change rapidly is an assignment which is certainly challenging, always interesting, and sometimes very successful.

Section K: System Research and Management for State and Local Systems

Chairman: Harvey Brooks, Dean of Engineering Division and Applied Physics, Harvard University

Harvey Brooks

The New York City RAND Institute was established as a focal point within RAND to apply "systems analysis" to the problems of New York City. This kind of work was different from RAND's previous experience. Thus we are concerned here with both the application of systems analysis to complex urban problems and the way in which such an application ought to be organized.

Three broad issues have been raised by RAND's experiences:

1. Who should serve as the financial sponsor for urban research, basic and applied?

2. What are the relationships which must be developed in urban systems analysis work? What are the necessary and effective organizational structures and institutional arrangements?

3. How can we capitalize on successful research? Research is a risky investment, especially from the view of the individual city official. The ability to make use of research in changing operating procedures, as well as research management skill in general, is a scarce commodity, and its availability definitely limits possible use of research in most public agencies.

Mr. Campbell then responded to a series of questions.

Q: What kind of work statement did RAND use in New York?

A: For each research project there were negotiations between the relevant agency, the Bureau of the Budget and Mayor's Office, and RAND. It was agreed that it is difficult to pin down useful research in advance, and that, therefore, it would be preferable to use a rather loose work statement, consisting of a few sentences describing each individual research project, and concentrate on developing close mechanisms for continually conferring with the agency client. The Fire Department is an excellent example of this kind of close working relationship. Some agencies were hesitant about accepting such a casually-worded agreement; the Police Department, for example, required specific annual milestones in its contract with RAND.

Q: What changes have been brought about in New York City as a result of RAND's work?

A: Obviously the city has not been transformed since RAND began its work; a transformation in the future appears equally unlikely. But there have been some definite gains, and more substantial changes seem possible in the future. The Fire Department is the most conspicuous success story, with "slippery water" and other innovations bringing a marked improvement in the City's fire-fighting capabilities in the immediate future. In the Police Department, which is similar in many respects to Fire, it seems much more uncertain how much influence RAND's ideas will have. Many may not be put into practice. The Housing and Development Administration involves research of a much more basic nature, but we are optimistic; we believe that even this year we will begin to see a substantial influence of our work on the City's new housing policies, especially on its allocation of resources to different programs within the housing field.

In general, however, it is very difficult to assess the real impact of RAND's work in New York, and I believe this will continue to be the case. The reason for this is that by the time an idea generated by research is tried out, two things have happened: First, the system has already changed substantially, making it impossible to say whether the analysis leading up to the suggestion was correct. The city is not conducive to controlled experiments. Secondly, and perhaps more important, by the time an idea is actually implemented it has gone through a great deal of modification and refinement--it has become operational. At this point the client is so deeply involved in the idea that for all practical purposes it is his idea, not yours. RAND's responsibility is to initiate and support this adaptive process. In fact, it is essential that this loss of identity takes place: perhaps more than anything else, client agencies fear loss of control over their own affairs as a result of RAND's presence. RAND must ensure not only that this does not happen, but that it does not appear to occur. The key word at RAND is "assistance," never "management" or "control." Systems analysis is as much an instrument of persuasion as it is one of decision. This idea is essential to understanding the success or failure of systems analysis in a given situation.

Q: Would you discuss the transferability of results from RAND to other cities? Must every city have its own research capability?

A: I believe that three points should be made about what is admittedly a very complex question. First, such transfer will take time in almost every instance. There is no other city like New York, but many cities have problems similar to New York's. Adaptation must occur in every case, even in the most technologically-oriented of our solutions, e.g., "slippery water." Second, following from this, a great deal depends on the substance of local conditions and issues. What is important for one city may not be for another; similar problems may have different underlying causes. Different traditions may be at work shaping the quality and quantity of interventions in the public sector. But even for cities which resemble New York in one way or another, a third comment should be made: most of the applicability of RAND results in New York will be in the development and testing of new analytical techniques and ways of studying urban problems. If a concept has borne fruit in New York, it will be a rather simple matter to see whether it is applicable to conditions in another city. Most of the studies that have been done in New York will, of course, need to be redone for every other city. But the point is that such studies can be redone quickly and at much lower cost, with fewer skilled personnel than was the case in New York.

Q: Did RAND have a strategy for beginning its work in New York?

A: What little strategy we have now has come as the result of experience. Basically it amounts to this: to get accepted, build small successes into bigger projects and bigger successes. We really couldn't tolerate failure in our early situation in New York. We needed some quick successes, and luckily "slippery water" and a few other bright spots appeared. We have found that it is best to do key parts of large projects first, expanding later to be more comprehensive as we learn more about the problem and can better identify the promising areas for analysis.

It seems quite necessary to bring the concept of risk capital to small agencies, say on the city and county levels. In doing this it is by no means necessary to begin at a large scale. In any urban situation there are likely to be a number of useful small teams.

It would be very helpful if we could bring the concept of research as risk capital to officials in city and county agencies across the country. It is an idea quite foreign to present conceptions of administrative responsibility, but no research is ever entirely predictable in its outcome. In order to give small agencies a taste of research, small projects, limited in scope, staff, and risk, are most useful. There are many examples of useful small team studies of limited topics. The most important thing is to create an ongoing community of officials with experience in relating to research. For this reason RAND has worked on an agency-by-agency basis, making sure that a good working relationship was established in each case before expanding small projects or initiating new ones. The difficulty with this is that attacking problems covering several agencies becomes a very difficult task, especially if the agencies involved are not used to cooperating together (which is very often the case, for often the mere existence of a problem overlapping the areas of responsibility of several agencies will provoke conflict and recriminations). Considerable size and sophistication are needed to attack such a problem, because the problem of maintaining relations with the client agencies is amplified severalfold. Eventually the problem of the lack of city experience in buying and using research may have to be solved by the development of general guidelines and standards, perhaps by the federal government. The administration of defense research can offer many useful lessons if DOD's experience is skillfully analyzed.

The question of the proper organization of research across governments has received very little attention. Perhaps it would be possible to develop core research capabilities in a few places on the order of the New York RAND Institute and provide them with a consulting function so that a small research staff in, say, Albany could call on more sophisticated analytical capabilities when necessary, especially after the preliminary analysis and formalization of a problem.

Q: What is RAND's relationship to the universities in New York City in addressing urban problems?

A: RAND really is not a competitor of universities in addressing the problems of New York City. The City's universities represent an enormous intellectual resource whose breadth and depth RAND, with its small staff, could never match. Instead, RAND and the universities have worked out a relationship that is essentially complementary. The universities have in most cases had little experience with problem-solving; they are not organized to address themselves to interdisciplinary problems on a continuing basis, and they usually have only the most tenuous connections with the City administration. Therefore, RAND in many cases serves as a broker between the talent of the universities and the problems of the City, organizing them and bringing them together. This use of university consultants allows RAND to keep its own staff small, flexible, and in close touch with their opposite numbers in city agencies.

Another important issue is the question of what might be called "critical mass" in public systems research. Is it better to have RAND addressing a number of interrelated problems in a city rather than merely concentrating on one or two? This is by no means clear, and our present distribution of effort was determined on other grounds, but we might expect that a broad enough attack on the problems of a single city might result over time in a synthesis of ideas. Greater experience with the affairs of a city should allow the identification of really fundamental problems, just as seems to be happening on a smaller scale in our investigation of New York's housing problems. One way that this might come about is through the development of generalized intellectual and methodological tools. "Research capital" can best be accumulated in a large operation. This has certainly been true in RAND's defense work, and the government could certainly increase the productivity of the present RAND effort through the provision of money for the generalization of our present research experience and the development of methodology with a long lead time. This would also allow more work on inter-system relationships within the city, perhaps eventually leading to the analysis of the city as a whole complex system.

Mention of development of methodology and generalization of results again raises the important issue of the potential role of the universities in urban systems analysis. I believe there is a gap between the operational problems of the city and university research in many cases. RAND and the academic world have different goals: we are primarily an applied problem-solving organization, the universities only incidentally so. Policy-related research is not always intellectually stimulating. There is also the problem of project continuity and time horizon. Universities require considerable continuity of staff and supporting workers from year to year; they have difficulty in organizing ad hoc to deal with a particular problem and then disbanding the team when the problem is solved (or when, as is more often the case, the funding is cut or terminated). They, in general, cannot work in short time periods or work closely with the operating personnel of city agencies. Thus, at least until now, the universities have not been very effective in dealing with the kinds of complex applied policy problems in which RAND is addressing itself in New York. Other types of problems may make much better use of the universities' resources, of course.

Q: Is federal money presently available for work such as RAND is doing in New York?

A: All of RAND's funding in New York is coming from the City itself. There are a variety of federal and state programs which might conceivably support applied systems-analysis work, usually as part of a larger effort to upgrade the performance of particular operational areas, e.g., law enforcement. This funding is for specific projects and requires the ability to specify clearly in advance what concrete results will be achieved, something that in our experience has proved very difficult, especially at first. In the near future, as a result of RAND's preliminary work, New York may be able to use specific programs to finance the implementation of particular reforms. This points out the need for some general capability for systems research and a good deal of preliminary work defining problems and proposing solutions before specific funds can be applied for. One way of circumventing this dilemma might be an institute established to provide money for initial studies and general work of the type we are currently doing for New York City. It might also be possible for an organization such as RAND to work for the large cities of America collectively, but as I pointed out before, there are definite limits to generalization about urban problems.

Q: There have been a number of attempts in recent years to establish "urban research institutes" to apply scientific analysis to urban problems of various types. The Urban Institute and the regional laboratory concept come to mind. Would you say that the misfires such as these outnumbered the successes such as RAND? Why?

A: It may be too early to evaluate many of these attempts to apply systems analysis to urban problems; RAND was one of the earliest into the field, and it had some difficulties getting started and is only now beginning to show results. The Urban Institute should eventually prove itself. But this is a difficult area in which to work. Three ingredients seem essential to success:

1. Sophisticated management: problems are complex and resources (both money and able staff) are scarce. Therefore, it is important to use them with some care, attacking manageable problems and pursuing them to operational results but knowing when to pull out of a hopeless case.

2. An active and demanding client: urban problems are the problems of a particular city, as defined by that city's administration and its operating agencies. There is no way to address urban problems without close and continuing cooperation from people actually working on a day-to-day basis with

the problems, for these are the people who will in the end have to make use of your solutions.

3. Intimately connected with (2), the ability to get into the field yourself and see what is happening.

Section L: Organizational Fragmentation

"The Siege of Fort Lincoln, Circa 1969; A Study in Non-Participatory Technology: Summary"--James D. Carroll, Professor of Public Administration and Political Science, Ohio State University; and John Zuccotti, Attorney

This is a story of participatory technology denied. In 1967 President Johnson instructed his subordinates to develop a new town in northeast Washington, D.C., on the site of Fort Lincoln. They tried to do so, but they failed to structure bargaining and brokerage processes to resolve the conflicts of interest and demands that arose in the technical planning stage, and they failed to develop effective strategies to circumvent obstructionist veto power tactics exercised by neighborhood political activists. The fragmentation of perceptions, interests, and responsibilities structured into the multiplicity of governmental organizations in the District formed a system of disincentives to the actors to see the undertaking as a coherent political process and to deal with it accordingly.

In the absence of structured ways of resolving differences in perception, understanding, and intent in the development of Fort Lincoln, the technical planning process became the _de facto_ locus of political decisions, such as the decision concerning the percentage of low income families to be housed on the site. The technology of development was not politically neutral, nor were the hardware technologies envisioned for the site. For this reason, a version of participatory technology was warranted as a means of reconciling diverse perceptions and objectives.

Section M: Mechanisms for Resource Allocation and Program Evaluation

"The Introduction of PPB in Philadelphia"--Richard E. Wall, Deputy Director of Administrative Services, City of Boston

Within the city government of Philadelphia, there are three groups of people with substantial influence on overall City policy: the planning group, the finance group, and the program management group. Each of these three separate groups is headed by a high level official of the city government, and these three officials are about equal in their level of status and power in the city government. They are, respectively, the City Planning Director, the Director of Finance, and the Managing Director.

Reports of the Defense Department's wondrous new system of management, called Planning, Programming, Budgeting, reached the planning group first, since this group is, generally speaking, a little more sophisticated and more addicted to innovation than the other two groups. The apparent opportunity that PPBS offered for a much better method of combatting major City problems led the planning group to include in their Community Renewal Program the recommendation that the City develop a PPB system under an organizational structure that would be staffed and controlled by the planning group.

This recommendation was successfully headed off by the Director of Finance and the Managing Director, who quickly detected the danger to their own positions of power. Shortly thereafter, however, the Director of Finance persuaded the Mayor and the Managing Director that the City should develop a PPB system under the Finance Director's leadership.

Accordingly, in the fall of 1966, the Mayor publicly announced that the City was going to develop a PPB system for which the Director of Finance was to be responsible. Inevitably, the Budget Bureau in the Finance Department was given the primary task of developing the system. The case reporter at that time was Chief of the Operating Budget Division in the Budget Bureau, who was responsible for the preparation and the administration of the City's annual operating budget.

The process of recommendation by the planning group and the ultimate decision by the Mayor that PPB would be developed under the Director of Finance took approximately one year.

The stated reasons for the decision to develop the system were that PPB would correct basic weaknesses in the existing budget system, and that it would also assist the City in obtaining grants from federal agencies. The unstated reasons were the urgent nature of the City's major problems and the failure of previous attempts to solve those problems. PPB seemed to offer a technique which could aid the city government in developing better solutions.

The primary obstacles to development of the PPB system were bureaucratic conflicts of interest and technical difficulties. It is axiomatic that for a PPB system to be successful, there must develop a substantial degree of cooperation between the planning people, the program people, and the budgeting people; yet these three groups were continually in a tug-of-war. In addition, some of the major efforts to combat City problems were in the hands of quasi-public agencies such as the Redevelopment Authority and the Southeastern Pennsylvania Transportation Authority, which were often in conflict with the top level City officials.

The technical difficulties primarily involved lack of knowledge within the city government of what a PPB system was, and the unavailability of trained and experienced personnel, who could be hired by the city government.

Not unnaturally, it was decided that the process of implementation would revolve around the operating budget. It was also decided that a gradual, phased, evolutionary process of development of PPB would be undertaken, by which the city government would first do those things which were within its current capability, and then take successive steps in developing the system as its knowledge and capability increased, making sure that each step would serve as a foundation for future steps. Consequently, to insure the cooperative assistance and uniform understanding of PPB by all segments of the city government, the Finance Department contracted for a PPB training program and invited all segments of city government to send representatives. Immediately after the training program, all segments of the city government were enlisted in the task of developing a program structure oriented to the City's major problem areas such as housing development, transportation, law enforcement, etc. The development of this program structure was tightly controlled by the Budget Bureau to make sure that it would be unified, cohesive, and compatible with accounting and budgeting requirements. All agencies were then required to prepare their 1968 operating budget requests on the basis of the program structure, and were instructed to provide substantial information on objectives and outputs of their program elements. Meanwhile, the Accounting and Data Processing Bureaus were put to work to revise their systems to begin recording and reporting expenditures on the basis of the program structure beginning January 1, 1968. Accordingly, the 1968 operating budget document presented the budget requests by major programs, each of which was divided into subprograms and program elements. This budget document also presented the capital budget proposals and the estimated budgets of the quasi-public agencies in the appropriate places in the program structure. This document was published at the end of September, 1967.

It would have been logical to proceed from this point to a large-scale attempt at program analysis, by which we would have attempted concrete and comprehensive definition of the City's major problems, established specific long-range objectives based on those problem definitions, and begun cost-effectiveness analysis of current and alternative methods of achieving those objectives. However, more pressing matters at the time were occupying the attention of the City's top-level officials, and we could not get the necessary support for large-scale analysis. Consequently, the year of 1968 was occupied with experimental efforts in program analysis by the Finance Department working with a few agencies who were most receptive, and with refining the program presentation in the budget document. The experimental analyses were of the Health Department's venereal disease control program and the City's Housing Development Program. Both of these efforts demonstrated the value of the approach to our own satisfaction, although for reasons of lack of funds and other limiting factors, neither of these efforts was pursued to completion. However, they did demonstrate that the analytic technique would substantially clarify the issues, yield greater understanding of current programs, and provide a better basis for measuring progress.

Early in 1969, conditions improved for top-level support of a large-scale analysis effort. Accordingly, a closer liaison was established by the Finance Department with the City Planning Director and his staff, as a result of which a major analytic effort was begun by means of program task force committees made up of key figures from the major agencies involved in each program, and with staff work for each committee provided by the Planning Department and the Finance Department. The initial assignment for these committees was to define each of the City's major problems and develop long-range objectives in each major program area.

The progress of these committees varied according to their level of sophistication. The most serious obstacle to the work of all the committees was the lack of solid data on the nature of the major problems. Without considerably more information on the nature of the problems in each major program area, it was impossible to establish concrete and specific program objectives. However, several of the committees succeeded in identifying clearly what data were needed and formulating plans for the accumulation of that data.

At the present time, the City is preparing its third program budget document. The further progress in the development of the PPB system will depend on the quality of the material produced by the departments for this budget, and on the successful pursuit of the analytic effort subsequent to the production of the budget document currently in preparation. An application for a substantial federal grant to assist in the support of that analytic effort was submitted last fall, and latest indications were that the application would be approved.

Section M: Mechanisms for Resource Allocation and Program Evaluation

Chairman: Selma Mushkin, Project Director for Studies in State and Local Finances, The Urban Institute

Dr. Mushkin opened by describing the "problem" thusly: "State and local government is full of problems. Both the legislative and executive branches have serious problems. The public doesn't respond to even the best of efforts sometimes. There are technical problems getting on with studies about other problem areas. How best do we decide how to allocate our resources between these problems and how do we judge later whether our allocation could be improved upon?" An optimistic approach to new allocation techniques might be "a little bit of better is better than nothing at all."

Following Mr. Wall's presentation of the introduction of PPB in Philadelphia Dr. Mushkin pointed to several differences between the New York City and the Philadelphia experiences in installing PPB. The aim in both cities of course, is "better government." In New York, as contrasted with Philadelphia, the executive gave the program strong support. In Philadelphia, the mayor did not make PPB an issue in any way and he had no prestige riding on its success or failure. Consequently, he gave it only mild support. In New York, on the other hand, Mayor Lindsay gave it very heavy support. "If Lindsay had been defeated," Dr. Mushkin claimed, "that would have spelled the end of PPB in the cities." This is so because there were plenty of people in municipal government in New York who were opposed to the mayor's reelection primarily because of their resistance to the PPB system. The PPB people (budget bureau and the RAND Corporation) in New York could easily get people in city government to talk to them and help them because they were doing the "mayor's job."

In New York, the main problem was the relationship between an outside group (the RAND Corporation) and the public agencies. One advantage of this, as compared to having each agency handle the question for itself, is that the consultants will not be confined to the same tired old solutions to problems, but may come up with new ones. For example, maybe the problem of alcoholism could best be solved in the schools. The Public Health Service, which is studying the problem in Massachusetts, wouldn't discover this if it were so. They think exclusively in health terms. New York had an outside agency impose the system and carry out the studies. Philadelphia used the existing structure but tried to integrate all problem areas across all agencies at once. Each agency designated what its contribution should be. A final difference between was that because the mayor had made such a big issue of installing the system, that to justify his public support, and the accompanying expenditure of funds and other changes in city government, a short run pay-off was needed. Dr. Mushkin noted that in Philadelphia, Richard Wall had managed to get good "cross-agency coordination" on problems from the beginning. She asked Mr. Wall to explain how this had been accomplished and if he felt that, in fact, it had. Mr. Wall said that it had and that he thought the training program which they had conducted was largely responsible for the success.

Dr. Mushkin suggested that research be directed to describing the "system," identifying the components and how they relate and perform. She pointed out that fairly soon, the expenditure for civilian services in state and local governments would exceed $200 billion. What proportion of these resources should be devoted to research and development?

It was suggested that the most important area where efforts were needed was in evaluation of the performance of government, and that a separate organization be developed in city and state government to perform the evaluation function. This body should have personnel trained in evaluation. This type of evaluation would produce greater efficiency in government. It should be third party evaluation in order to avoid the bias towards painting a rosy picture inherent in asking an agency to engage in self evaluation. It was also suggested that this separate evaluative organization include those who receive the services. The public--the consumer--should be included in the evaluation process.

Beyond the difficulties in estimating benefits from public programs, there still remain unresolved problems, both conceptual and empirical, in determining program costs and in developing adequate managerial control procedure. The PPB must be integrated with the budget in order to determine program costs. Only then do you really know what's going on, no matter what you tell people to do and no matter where you think your money is going. Dr. Mushkin noted that there was an opposite view which held that PPB should not be integrated with the budget. To seek integration is to alienate the old line-item people which staff budget sections and risk having the whole program sabotaged. In Philadelphia old line-item budgets were maintained to keep the accountants happy, at the same time that a program control system was developed through the use of cross-walks from the line-item budget categories to the program categories. It was argued that it makes sense to impose the program system for decision making without first integrating it with the budget. If one waits for the perfect cost information system, it may take ten years before the PPB system is installed.

The issues of the amount and direction of research support for domestic programs as well as the criteria for reaching these decisions were raised. In the health field, about $1 billion annually is spent for research. This is about 5 percent of the nation's "health economy." The real problem is that much of this is spent not on the problems that affect most people's health, but on very theoretical questions such as complex molecular structures, etc. Public health and care which would produce the most obvious gains are neglected. Not much at all of this amount is spent on demonstration projects.

Dr. Mushkin proposed, then, that the section recommend to the conference that 1 percent of the amount spent on city and state problems (or, at least $2 billion of the $200 billion total city and state budget) be spent on research in this area. The proposal met two responses. One, the amount proposed was too large because, unlike agriculture, most of the public problems did not require research; they simply required a political solution--somehow getting the support to do what we need to do. Two, the amount proposed was too little. This view received wider support.

Other questions were raised on how one decides the proper level for research, and the proper amounts to be spent on each level, federal, state, or local. Also, the basis on which one decides between short-run and long-run aimed expenditures--in programs and in research.

Robert Marden pointed out that those who felt the figure was too much and those who felt the proposed figure was too little had in many cases been talking about two different things when they referred to R & D. Marden noted that it's wise to keep these two questions separate: (1) how do we get better management? and (2) how do we get better services in substantive areas? Additional knowledge in many public areas still remains the most critical need. For example, how do people become alcoholics? How can we get them to stop? No one has any idea what the answer to either question is.

Some opposing views were expressed. States make a mistake in trying to plan their budgets. Since much of the administration which has the most significant effect on problems goes on at local levels, states would do better trying to influence municipal resource allocation methods than trying to perfect their own. This, admittedly, is politically difficult, since states have developed some fidelity and reverence for the concept of the inviolability of home rule. But it might be more efficient for the states to spend their money in such a way as to induce better behavior at the local level rather than worrying about the state level. It was also argued that one had to identify the "real" problems before we decide how much we should spend on research. Dr. Mushkin responded by noting how serious were most of the nation's problems. Moreover it is "inexcusable" for a scientist to say that these problems were "impossible." Even though the problems were much more complex than getting someone to the moon, we have, thus far, put little scientific effort into their solution.

Criticism was voiced of the scientific approach being advocated. "We're dead" if we continue to describe these "problems" in terms of "subproblems." Most of the problems are, in a substantive way, not that tough. The structures of state and local governments, however, inhibit the solutions. The real problem in many cases is a people problem. Getting government people to understand why they are doing what they are doing is the main problem. You can't just bring in an outside group of analysts and tell the agency what's wrong with them. Agency people themselves must understand what they're doing or else the outside group will shatter morale and produce no continuous change. Philadelphia's "incremental" approach to introducing PPB through the existing structure over a long time with training of the agency people is preferable to the New York strategy of bringing in an outside group.

Alternative techniques for resource allocation within and between program areas were discussed. Learning more about the problem was seen as a first step. When one studies a problem, many of the answers to further allocation questions emerge.

The "bring in the think-tank" approach was again criticized. Greater use of universities was suggested as an alternative.
Dr. Mushkin pointed out that the standard government criticism of

university work is that the academics redefine the problem so that they're interested in playing with it. This isn't useful. That's why most governments don't rely on universities for work in areas where goals are not clearly defined and quantitative simple answers cannot be given. To be helpful, Richard Wall maintained, you must want to help. To do this, you must subordinate yourself to the person who has the responsibility. Too many problems' "solutions" end up on the shelf because university people say, "I'm going to study your problem and tell you what to do." That's not usually feasible. The administrator usually can't do it. It is necessary to get communication all during the process of analysis, between the implementers and the analysts. No problem will be solved until the analysts get way down into the bowels of bureaucracy and start relating analysis to the people who will implement it rather than do it all at the governor's or at the mayor's level.

But how, without the quick results that an outside group can bring, Dr. Mushkin asked, do you get money for it this way? Moreover, it is far more likely that an "outside" rather than an "inside" group would concern itself with the following (somewhat exaggerated) type of question. "Rather than reform state government (and spend whatever money that reform would take), maybe it would be more efficient to make it smaller if it doesn't perform, and save the money."

Another participant suggested that PPBS itself, whether done "incrementally" or by an outside group (i.e., RAND, etc.) may be, by its very nature, conservative. Since it asked questions about how government performs, and much of it must be done inside government, PPBS may not adequately consider the possibility of new institutional mechanisms. In the private sector, technological change invalidates obsolete institutions, but we have not found a way to make governmental institutions respond to change. Can some sort of competition be built into governmental institutions?

How, another participant asked, can we really find out what the citizen prefers? Do we take community surveys? How can we get real citizen participation? Dr. Mushkin suggested that for a starter in most areas we could do much better if we just asked.

Another participant complained that the people who allocate resources don't usually understand the problems. They are too far away from the problem. More allocational decisions should be made at the local level. The rejoinder was that PPBS can't be instituted except at a higher level, so this is a counterbalancing factor which makes higher level decision making more rational, at least as far as the whole budget is concerned.

Section N: New Structures for Federal, State, and Local Government Cooperation.

"New Structures for Federal, State, and Local Government Cooperation"--
Adam Yarmolinsky, Harvard Law School

The benefits of innovation in science and technology are spread through society only by institutions adapted to the process of dissemination. State and local government can only interact with the science and technology community when their institutions, and the complementary institutions of the federal government, are adapted to reach out for new developments in science and technology, and to press for contributions by science and technology to the resolution of state and local problems.

To try to make science and technology serve the needs of state and local governments is scarcely to write on a clean slate. Existing government agencies, by and large, have a considerable stake in existing technologies. The federal Bureau of Public Roads, and the corresponding state and sometimes local agencies, are committed to the basic existing technology of owner-driver-passenger rubber-tired highway transportation, even where quite fundamental innovations may be appropriate. Housing finance agencies have quite specific ideas, sometimes unarticulated, about the proper limits on technological innovation in large-scale housing. And the bureaucracies of education and of law enforcement are both oriented toward labor-intensive methods of carrying out their day-to-day operations, and correspondingly skeptical about labor-saving technological innovations, from teaching machines to automated emergency vehicle dispatching systems.

General hostility to innovation is a natural and understandable characteristic of bureaucracies, and cooperative arrangements among complementary bureaucracies, federal, state and local, tend, unless otherwise directed, to reinforce this characteristic. Without institutional changes to accommodate the process of scientific and technological innovation, its benefits may not be sought, or, when offered, they may be rejected out of hand for fear that they will disturb existing institutional arrangements.

The three structural prerequisites for increased availability of science and technology input to state and local government are money channels, manpower channels, and action channels. Structures must be designed or redesigned to permit the adequate flow of funds, the availability of manpower, particularly skilled manpower, and the expeditious taking and carrying out of decisions, with due regard to externalities.

Two difficulties cut across all three requirements. First, state and local governments are by tradition unreceptive to the employment of the resources of science and technology. The fifty states taken together spend only $90 million on research and development, and local governments add perhaps another $50 million. The bulk of the research and development funds spent by state and local governments come from federal sources. Outside of agriculture, where there is a well-developed and well-financed tradition of employing scientific and technological resources, and spreading the results to all possible users, state and local governments do not reach out for these resources, and even tend to regard them with some suspicion when they are offered.

Second, state and local issues tend to be highly political, in that the execution as well as the choice of policies involve immediate questions of the division of power and economic benefit among differing groups of citizens and voters. Building the POLARIS submarine fleet or getting a man on the moon were tasks uncomplicated by disagreements as to the role of the community, or of rival factions within the community on the technical shape and content of the program. Clearly technological decisions have policy consequences in any context, but the main lines of policy are more likely to be continuously at issue, and to be inextricably intertwined with questions of technological means, at the state and local levels. The decision where the lunar module should alight on the moon was technically an extraordinarily complex one; but it did not involve assessments of the relative political strengths of the inhabitants of the Sea of Tranquillity and the Ocean of Storms.

The problem of state and local resistance to the use of science and technology, and the problem of political interference in decisions on issues of science and technology, complicate the handling of all three structural problems--money, manpower, and institutional structures--but by the same token, they make the best resolution of these problems all the more important.

Money is an increasing problem for state and particularly for urban government. Science and technology may be employed to increase efficiency and thereby lower costs, but they are more likely to be employed to increase effectiveness so as to render better or wider service but at no lower or perhaps even somewhat increased cost. Even where technological innovation does lower cost (as in the case of automated dispatch systems for police emergency vehicles, or low-pollution solid-waste disposal systems) the capital costs of the innovation are likely to be large and visible, while the savings in operating costs are so stated in old-fashioned government accounting systems that they are difficult to isolate and point to in advance of installation of the new techniques or equipment. Because the costs are likely to be obvious and immediate, and the savings delayed or indirect, persuading state and local governments to undertake major expenditures for technical and scientific innovation is a particularly difficult task.

One way to get at this problem is to modernize the budgeting and accounting procedures of state and local governments by the introduction of planning, programming, budgeting systems (PPB). The system has at least two advantages for our purposes: it encourages agencies and departments to clarify their objectives, by requiring a functional breakdown of spending; and it reveals the full cost of alternative ways of achieving stated objectives, which are projected several years ahead, to the end of the feasible planning period. Opportunities for more efficient or effective operations are highlighted by applying PPB, and resistance to scientific and technological innovation may be reduced accordingly.

Another way to get at the problem of channeling funds more easily and directly into scientific and technological innovation is to increase the flow of funds. States and localities are chronically strapped for funds. State and local governments are growth industries, and labor-intensive industries as well. The taxing power is largely preempted by the federal establishment, and smaller jurisdictions are necessarily limited in their taxing power not only by the size of the federal bite, but because any jurisdiction that attempts to increase its own take significantly runs the risk of driving individual and corporate taxpayers to move elsewhere, thus depleting the local tax base. Then too, taxable resources are not equally distributed to begin with, and urban areas tend to find increasing costs coinciding with decreasing taxable wealth and income. Lastly, the taxing instruments primarily used by states and localities have a variety of built-in defects. The property tax consistently lags increases in GNP, and is difficult to administer equitably, while the sales tax is regressive, unless limited by substantial exceptions that curtail its revenues.

All of these considerations suggest the desirability of making the superior tax collecting abilities of the federal government available to the states and localities through some variant of block grant devices like the Heller-Pechman plan. The essential elements of such a plan are the allocation of a specified percentage of the federal tax base for distribution to the states, essentially without strings; a state-by-state distribution formula, based on population, perhaps adjusted to reward high state tax effort and to compensate for low per capita income; and a pass-through formula to make sure the localities get their fair share. The Heller-Pechman plan is not proposed as a substitute for categorical federal grants--which are particularly appropriate to deal with state and local problems that have overflow consequences beyond state boundaries--but as a supplement to such grant programs.

Since state and local governments also rely heavily on borrowing, particularly to procure capital assets which are likely to be instrumental in applying scientific and technological innovations, new schemes to increase state and local borrowing capacity are also relevant here. Recent efforts to remove the federal income tax exception for municipal bond interest have highlighted the inefficiency of the exemption as an aid to state and local borrowing. The bond exemption is likely to remain on the books for some time to come now, but supplementary devices have been proposed, including the urban development bank (Urbank) which would provide a federal guarantee for the credit of urban local governments, and would also make up the difference between the market interest rate and a lower subsidized rate to be paid by the municipality. A relatively small investment of federal funds would therefore generate a large increase in local borrowing capacity.

A third general way in which it has been suggested that the federal government could ease the financial burden on state and local governments, freeing up more funds for science and technology, is for Washington to assume particular obligations now borne largely by the states and localities. A prime candidate for such transfer is the welfare bill, particularly in view of the increasing pressure to standardize welfare payments across the country, and to revise the present system so that it contains positive incentives for those on welfare to enter the labor market, rather than the present disincentives.

Even assuming that ample funds are available to the states and localities, the availability of skilled manpower and of politically responsible leaders capable of responding to the challenge of science and technology remains a major problem. The principal manpower bottleneck in state and local governments is the civil service systems that impose rigid and out-of-date qualifications, endlessly time-consuming hiring procedures, salary scales wholly inadequate for professional personnel procurement, and conditions of work that discourage eager, imaginative recruits.

These systems, designed to replace political spoils systems in a loose job market where government demanded few special or scarce skills, are wholly out of tune with the need for highly skilled innovative professionals, particularly in applying science and technology to the requirements of state and local governments.

The constraints can be circumvented by such devices as the public or quasi-public corporation, of which more below. General civil service reform is a constantly recurring item on the agendas of public interest groups, but one that seldom gets beyond the legislative committee room.

The federal government cannot assist directly in this enterprise, but it can provide indirect assistance in two ways: by offering technical assistance to state and local agencies, where they cannot provide their own technical staffs at sufficient levels of competence--or where outside advice and assistance can help to increase the technical competence of an existing staff. And the federal government can set an example in its own civil service system in order to encourage changes at lower levels of government. Salaries in the top levels of the federal civil service for a time lagged behind the most advanced of the states, but Washington has again taken the lead. The special federal statutory authority (P.L. 313) for compensating certain scientists and engineers who are performing professional but not executive duties at rates comparable to the highest in the federal executive pay scale is another example of useful innovation, attempting to set a pattern for the states. New federal programs for mid-career training and education, exposing career officials to new currents of thinking and new methods of problem-solving, provide models for state and local government personnel management--although still so far in advance of state and local practice that they may be almost out of sight.

The increasingly extensive use of scientific and technological expertise at the policy-making level in the federal service has also set a useful example for state and local government. Because the President of the United States has a Science Advisor and Science Advisory Council, which includes some of the most prestigious scientific figures in the country, it becomes more appropriate for governors and even mayors to appoint science advisors and advisory councils. And because the whiz kid has been institutionalized as an assistant to federal policy makers (despite some backsliding in Washington in the last year or so), state and local governments are more willing to accept whiz kids and to tolerate their iconoclastic attitudes toward established governmental folkways.

Adequate funding arrangements and flow of technically qualified, technologically-oriented manpower are not enough to facilitate scientific and technological innovation at the state and local levels, without new institutional devices as well, so that dollar resources and human resources can come together to produce actual results in the real world. These devices may be built within the existing framework of government and intergovernmental relationships, or they may be added as appendages to existing structure. They may be designed primarily (or exclusively) as links between various levels of government, or they may foster federal, state, and local cooperation only as a by-product of their primary function within their own level of government. But their common characteristic is that they cut across traditional categories of governmental activity, as the impact of advances in science and technology spreads across the spectrum of human activities, requiring the organization of increasingly complex systems of response.

Institutional innovations to facilitate scientific and technological innovations must increasingly be systems-oriented. They must be based on a view of the governmental process as involving many mutually dependent elements, with chains of consequences often extending far beyond the intended purposes of a particular action, so that an awareness of all the elements and how they interact is essential to avoid actions that may be self-defeating--and to initiate actions required to keep the system in working order.

Seeing governmental decisions as systems decisions involves in itself an initial application of the scientific method, which is facilitated not only by the availability of funds and manpower for systems analysis, but by the institutional forms in which government is organized. These can be considered under three heads, for purposes of this analysis: institutional arrangements within the federal government by which it reaches out to the states and localities, institutional arrangements within state and local government, and institutional appendages to government at various levels.

The federal government has given special recognition to its relations with the states and localities through the work of the Advisory Commission on Intergovernmental Relations, which has been taking a continuing critical look at the problems, and has come up with a long list of recommendations, some of which have already been mentioned above. Probably the major federal effort to inculcate a systems approach is in those federal grant-in-aid programs that require as a condition of a federal grant, say, for a local sewage disposal facility, evidence that the request is a part of a regional plan for dealing with the sewage disposal problems of the area. Too often, however, the required plans are simply expressions of generally desirable goals, rather than agreed statements of hard planning factors.

One of the great problems of federal-state-local relations, as the Advisory Commission on Intergovernmental Relations points out, is the proliferation of individual federal grant-in-aid programs. Outside of Model Cities areas, which are likely to be quite limited, there is no overall federal supervision of such grants for local consistency and priorities. One suggestion that has been advanced is the creation of federal executive agents in the places where major federal grants were concentrated, to serve as a kind of AID mission chief for the area. The resistance of local congressmen and senators to such a proposal has been sufficient thus far to prevent its being put into operation. The creation of the cabinet Department of Housing and Urban Development serves this purpose to a limited extent, but it still does not assure coordination with the Departments of Agriculture, Commerce, H.E.W., and Transportation, to name only the most obvious, each with its own local funds to disburse.

In making available federal funds for research and development, the federal government has failed to develop more than sporadic coverage of state and local substantive problem areas. There is no counterpart in the federal structure to the agricultural experiment stations and the agricultural extension service, both handsomely financed, or to the National Institutes of Health, currently somewhat scanted in funding, but organized to deal systematically with problems of health and medicine--omitting problems of health services delivery. The Office of Economic Opportunity and the Department of Housing and Urban Development have some research and development funds, but they are not organized to explore systematically the major current problems of states and localities, and then to disseminate their findings through an extension system. These problems may be too variegated to permit the development of a single research and development system, especially one that relies as much as the N.I.H. does on peer group evaluations; but in any event, an increase in federal resources seems desirable both for research and development on state and local problems, and for dissemination of the findings.

There has also been some discussion of attempting to develop an urban equivalent of the agricultural extension program, supported by federal funding, and working through universities as centers of teaching and research, that could reach out to urban communities in the same way that land-grant institutions funded under the Morrill Act provided centers of teaching and research for the development and spread of scientific agriculture. The analogy is not a perfect one, and it is not yet clear that universities are the best foci for such programs in the urban context, rather than community colleges, or adult education centers, or new institutions specially designed for the purpose. But the idea of federally supported urban extension seems well worth pursuing, in order to provide some new kinds of field stations which can apply the fruits of science and technology to local problems and complete the feedback loop from application to further research and more useful research results.

At the state and local levels, institutional arrangements to facilitate receptivity to scientific and technological advances must begin with efforts to broaden the scope of control of policy-making officials so that they can meet new problems and new opportunities without having to cross jurisdictional lines.

The creation of new super-agencies, each one including three or more smaller departments or agencies that had previously reported directly to the governor or the mayor, is an example of this process, as it is taking place in Massachusetts and New York City. It is most widely advertised as reducing the chief executive's "span of control" to reasonable proportions, so that he does not have more agencies reporting directly to him than he can possibly supervise. But it is directly relevant to our subject matter because it gives each superagency a scale of operations and a breadth of jurisdiction more nearly consistent with the fullest application of scientific and technological innovations. A city environmental protection administration is better able to apply science and technology to the resolution of problems of air and water pollution than separate departments of water supply, sanitation, and air pollution would be, and it is better able to take advantage of state and federal resources in this area.

It will still suffer, however, from the fact that its geographical jurisdiction is not broad enough to effectuate technological advances in pollution control. This difficulty can be mitigated somewhat by regional planning, among the relevant state and local government units. But planning divorced from action authority is of limited efficiency, and until local governments are prepared to delegate real authority--or states are prepared to allocate it--to appropriate geographical areas, local political boundaries will continue to inhibit severely the use of science and technology.

Super-agencies and regional authorities must still be reconciled with the growing pressure for community participation in local governmental affairs--which has a good deal to do with why it is harder to get a ghetto resident to and from a job in the suburbs than it is to get a man on the moon. The federal government has had a good deal of success with technological innovation by organizing project offices (as in the case of POLARIS nuclear submarine development) which cut across existing organizations with full authority to command necessary resources. Such a device is less appropriate for state and local government--although the problem of special interest veto groups is, if anything, greater at the local level--because it tends to omit a role for the community in the decision-making process, without which the decisions are likely to exclude legitimate political considerations.

Science advisors and science advisory councils at the federal government level may have their counterparts at the state and local levels, but these counterparts are likely to be less effective, simply because state and local governments are so much involved in operations at the point of contact with the individual citizen or group of citizens that a government unit organized on a non-operational basis has a hard time keeping up. The most effective place for scientific and technological policy advisors is probably on the staff of super-agency administrators, working in close cooperation with new style budgeteers and systems analysts.

Where state and local governments are too rigidly structured to take proper advantage of scientific and technological advances, they may leapfrog their difficulties by organizing new public or quasi-public entities, following the federal example in the Defense Department's creation of the Aerospace Corporation, or H.U.D.'s reliance on the new Urban Institute. These new entities can regroup functions that would be more difficult to combine inside government, and they can avoid cumbersome restrictions of public civil service systems. A striking case in point is the New York State Urban Development Corporation, discussed in a separate paper by Alan Talbot.

All these devices are intended to ease the way for new ideas about the uses of science and technology into the regular processes of state and local government. Sooner or later, these new ideas take hold. But there is still a very real danger that they will take hold too late.

Section N: New Structures for Federal, State, and Local Government Cooperation

"New Structures for Federal, State, and Local Government Operations"--
Allan R. Talbot

INTRODUCTION

Over the next ten years it is likely that the states will assume increasing responsibility for the urban growth and decay which have so clearly overwhelmed their smaller jurisdictions. The directions of some of these new state programs suggest new opportunities for federal, state, and local cooperation, including the application of new technology to urban problems on a significant scale. An examination of some new programs in New York State demonstrates the possibilities.

The Urban Development Acts of 1968

In the emotion-charged atmosphere following the assassination of Martin Luther King, Jr., on April 4, 1968, the New York state legislature--under obvious pressure from Nelson A. Rockefeller--passed the Urban Development Acts of 1968. This legislation, and the uniquely powerful agencies it created, have put New York in the urban development business in ways that will probably be emulated by other states in years to come.

The legislation was proposed and passed primarily as a response to the residential blight and economic stagnation of the state's urban ghettos. A report from the state planning office told the legislators that .8 million of New York's 5.6 million housing units were substandard; that 100,000 acres of urban land were blighted, and that local renewal efforts affected only 3,000 of these. The report tactfully reminded the legislators that existing renewal efforts were not only small in impact, but painfully slow in execution.

Another report, prepared by the Joint Legislative Committee (JLC) on Housing and Urban Development, demonstrated that the state's urban problems would be aggravated by population increase and current urbanization patterns. Supportive of the Urban Development Acts, the JLC report stressed that new growth and investment would probably bypass areas of need, such as the inner city ghetto and depressed upstate towns, unless the state intervened.

The acceleration and expansion of renewal in the cities was the theme emphasized by the Governor, who pledged that if the legislation were passed, the state would cut red tape, get financing, and attract the private investment needed to get local renewal efforts moving.

The Urban Development Corporation

The principal new vehicle for these purposes is the Urban Development Corporation (UDC), a statewide development corporation. UDC is authorized to undertake housing, commercial, civic, and industrial projects in urban areas. It can acquire land, by condemnation if necessary; and it can either serve as a catalyst for private investment and development or build and operate its projects by itself or through subsidiary corporations. It may borrow up to one billion dollars to finance these efforts, the money to be repaid from land or development sales and/or leases. To start things off, the legislature gave UDC five million dollars and loaned it another forty-five.

Of considerable interest is the Corporation's flexibility when it comes to local building codes and zoning regulations. The UDC board may ignore local zoning rules and it may revert to the state building code if local restrictions make its approved projects infeasible.

UDC's unique combination of public development powers is best understood by revealing two that it does not have. One is a subsidy for moderate and low income housing. For this, it must rely on the FHA and the State Housing Agency. It also does not have the ability to "write down" land. For most city projects, therefore, it must enter through the door of the local urban renewal agency.

Corporation for Urban Research and Development

The research corporation, a companion to the UDC having the same board and president, it is a private corporation designed to undertake demonstration projects which test new ideas in development design, materials, management, and structural systems. The research corporation must raise its money privately. Presently, it is a paper organization significant mainly for the manner in which its powers complement those of UDC. It does not have condemnation powers, although it may acquire land. Among the projects it may develop are single-family houses which do not seem permissible under UDC's enabling legislation. Moreover, the research corporation may acquire and develop land anywhere in the state. UDC's authority to buy open land away from existing urban areas is not clear. As of this writing, it appears that a state constitutional amendment may be required if UDC is to embark securely and ambitiously on a new town program.

The Current Program

The potential of UDC and its companion corporation are best understood through a brief review of what has happened so far. The record begins in July 1968, when Edward J. Logue became the president and chief executive officer of UDC. Those who know him can attest to the fact that he is at least as important in understanding the UDC as anything the state legislators may have had in mind.

Every new agency has problems. UDC's were mainly in the insecurities of local officials who viewed the combination of its powers and Logue's vigorous administrative style with some concern. Governor Rockefeller dispatched a letter to all the state's mayors informing them that UDC's doors were open for business. A good number of them replied, and it soon became apparent that even the most serious doubters, including John Lindsay, were prepared to unload their more troublesome renewal projects onto the new state agency.

During its first 12 months, the UDC entertained more than 100 invitations. By January 1 of this year, it had formally committed itself to 29 in ten cities. Architects have been commissioned on each of these, and five are close to the construction stage.

The UDC is not immune to the recent money restrictions which have plagued urban development. Its chief problem, therefore, is everyone's problem; and assuming the money flows more liberally, it is perfectly conceivable that within two years UDC will be building at a rate of 10,000-15,000 units per year, which is roughly one-sixth of the state's recent total annual production.

Program Opportunities

The recognition of this potential impact has produced some good questions within UDC about how it might use its leverage as a means of breaking new ground in technological improvements in components, structural systems, and the facilities that serve communities such as water supply, sewage treatment, and waste disposal--all of which have seen little change since the time of the Romans.

The principal reason why urban affairs has been so unreceptive to change is the fragmentation, diffusion, and multiplicity of individuals and institutions inherent in the processes under which we convert raw land into urban use, or rearrange uses on existing urban land. Very few individuals or organizations are in either a convenient or secure enough position to control a large enough portion of urbanization to offer it to the private sector for the development and application of new product ideas or new technology. The market is presently too small, fractured, and uncertain.

UDC's potential housing output and statewide jurisdiction, therefore, put it in a unique position. Unlike local government, which has other preoccupations and operates on too small a scale, or the federal government, which avoids direct involvement in the development process, the state government through UDC has the opportunity to assemble its projects on a large scale and offer them, or parts of them, as a market for new technology.

UDC's involvement in new technology is guided by two basic goals: reducing costs and/or offering a quality improvement in the final product; that is, designing and building a dwelling that works either for the family that occupies it or for broader community interests that are reflected in the need, for instance, to curb air and water pollution.

UDC's present moves in these directions are modest but important. They involve a thorough investigation of available "widgets" or components which after careful review are deemed worthy or desirable to be included in UDC sponsored housing. In other words, there are items now on the shelves of suppliers which can reduce costs or improve quality. Architects seldom have the time to evaluate them, so UDC is doing it for them.

To cite one mundane example, there is one plumbing firm that markets a commode which consumes only 1.5 gallons for each use; it's name is "mighty flush." Considering that the average commode consumes at least twice that amount, the savings in water consumption and burden on sewage treatment plants can be considerable if "mighty flush" is put to work in 10,000 or 15,000 units a year. There are also significant variations in the water consumption of other home hardware such as washing machines and dishwashers. Yet, to my knowledge, no one is evaluating and applying this equipment in light of the clear public interest which is served when the water consumption per dwelling is reduced.

Other available widgets offer savings either by virtue of lower purchase price, installation costs, or maintenance. These range from door frames to window sashes to roofing materials. Hopefully, all the products selected by UDC will be produced in New York State, but, significantly, that is not now the initial consideration.

The careful screening and application of existing products and materials are important not just for the modest advances they may provide. The process itself is important, for it establishes the fact that one public agency, a construction agency of significant scale, is concerned about components and structural systems and is offering a market for cost or quality improvement. From this important precedent, some new and more sophisticated approaches are beginning to emerge.

One involves working with other state agencies with construction responsibilities to determine how they might pool their component needs. Universities, hospitals, and office buildings may serve different functions, but they all need doors, generate garbage, and require ceilings. Pulling these agencies together is difficult, but it is inspired by the fact that state agencies accounted for roughly 20 percent of all construction in New York last year.

A parallel development will undoubtedly be a more complex review of actual building systems. It is inevitable that once UDC begins choosing low cost, easily installed door frames, for example, it will get involved in wall assemblies; just as its interest in commodes will undoubtedly lead to a consideration of bathroom cores. These investigations are already putting the agency in direct contact with manufacturers as well as with firms with new structural systems. The inquiry into better building components will lead to efforts to choose design systems that can put them altogether most efficiently.

Perhaps the agency's greatest potential, as far as technological advance is concerned, will be to test new ideas for sewage and waste disposal. A growing number of sanitary and civil engineers have joined the educators in their advocacy of decentralization--in this case, of decentralizing as much as possible the responsibility for processing and treating wastes generated in the home. Presently, the public sector is investing extraordinary sums on the transportation of wastes to other locations--rivers, marshlands, and continental shelf. There's a madness to all this which only in recent years has become obvious.

For example, one official of the Federal Water Pollution Control Administration estimated that $50 billion is required just to bring existing sewer systems up to acceptable standards, that is, providing sewers where they are now needed and separating storm from sanitary sewage in urban areas. Most plants to which the sewage flows are under-designed and poorly maintained. Along the Hudson River in New York State they account for much of the pollution. What is most depressing about the President's recently announced pollution control program is that he proposes adding patches to an anachronism. It will, quite literally, be money thrown down the drain.

The more one learns about water pollution the less clear become the possible solutions. But surely the nation should invest money in discovering new ways of treating sewage at the source. In the home, it may mean recycling water used for washing, and it may also mean eliminating water as the means of conveying sewage. There are prototype systems in existence which do both.

One New England city of 140,000 people, for example, recently received a bid of $60,000,000 for new treatment plants. Assuming it could ever get its hands on that money, this city would still be faced with substantial pollution problems due to its antiquated sewer system--the reconstruction of which would create unprecedented disruption of streets, buildings, and lawns as well as an additional $40,000,000 in capital funds.

It may be cheaper and more efficient over the long run, if the city had this $100,000,000, to turn it over to the owners of 22,000 dwelling units at about $4,400 per unit and give them three years to buy and install their own sewage treatment facilities. The effect of such a program would be a significant reduction of water consumption and a far more efficient treatment process, due partly to the fact that people would pay more attention to the pollution content of the materials they purchased as well as to those which they dumped into their own treatment systems.

The purpose of this example is not necessarily to advocate water recycling or decentralized sewage or waste treatment. Rather, it demonstrates how under existing institutional arrangements we are committed to ancient, obviously inefficient, and quite costly methods of handling wastes. Developing alternatives is difficult, as this example suggests. Local government has other preoccupations. It is doubtful that without a federal research incentive and a larger market than one city that the private sector would respond. So that in terms of this illustration, the property owner with a three-year deadline would find nothing to buy for his $4,400.

The stalemate in applied research on these basic urban needs is caused by the absence of a public client and an assembled market for it. The scale of effort that New York is attempting may demonstrate how this institutional vacuum may be filled. And when one is considering new technology in infrastructure, one is impressed with the possibilities presented by the new town, which promises to become a significant part of the UDC program in the next five years.

Generally, the state's record on urban needs is not inspiring. Yet the vehicle of a statewide development agency with the capacity to establish regional subsidiaries seems very useful. Such mechanisms can give the federal government a local partner to apply technology on a large scale and to assemble a statewide market that may be attractive to the private sector. UDC's interests and capacity to pull this off make it unique. Judging by the interest it is generating in other states, the nation will probably see more of such enterprises in this decade.

Section N: New Structures for Federal, State, and Local Government Cooperation

Chairman: Adam Yarmolinsky, Harvard Law School

Recommendations

1. Much technology now exists; the problem is how to apply it.

2. In order to create or adapt institutions to apply the technology, political leadership must be convinced that it will serve their political needs.

3. Technology must be addressed to the needs of populations.

4. These needs must be communicated to the R & D community at the state and local levels through politicians. The R & D community should also make independent efforts to sensitize itself to these needs.

5. No general guidelines are possible on the desirability of working through existing agencies of government or creating new ones. The issue can be decided only in the particular case.

6. It is important to assemble, through the institutions of government, sufficient demand to assure a market for new technological development.

7. There is a need for training programs for elected officials and political administrators which will demonstrate how to use R & D in ways which will maximize its political benefits and minimize the political costs and risks.

8. There should be an ample and regular flow of federal funds to state and local governments to conduct research and to build institutional linkages which allow the research results to be utilized effectively.

Individuals not institutions are innovative forces, but innovations cannot become part of the social fabric except through institutions. States and local governments, however, lack the money to undertake innovations which involve transferring scientific and technological solutions to government.

Even where additional money is available, as, for example, through federal programs, these funds are too often of a grant-in-aid variety, which limits the state's ability to define its own problems. The extent of interstitial policymaking by states and localities within the existing system of program grants was a matter of disagreement. Block grants from the federal government to the states and localities was advocated.

A division of labor with respect to R & D was suggested for different levels of government. States and localities were considered equipped to handle only applied research. They lack the skills to do basic research; moreover, the payoff from this type of research is too far distant for it to have much political appeal. New York's Urban Development Corporation was cited as an admission that local governments cannot adequately receive and use new technology. Rather than attempt to bolster their R & D capabilities, it was suggested that local governments could best be revitalized through the development of regional government.

Many local units of government were held to be dysfunctional. There is a danger in attempting to strengthen these units in their present configurations and resistance to change. This concern suggested that easy agreement on "pass through" formulas for revenue sharing should be avoided. Efforts should be directed at strengthening the capabilities of state governments to rearrange their local institutions. States should be given the prime responsibility for introducing science and technology within their borders. Federal funds should have strings attached which require that, to the extent resources go to local governments, they must change their structures to conform to the broad requirements of society.

The need to establish linkages between the federal government, local government and the universities was emphasized. Improved public relations about what the scientific community can do for local governments was also suggested.

There is a need for research on how to institutionalize the connection between R & D and the needs of the consumer.

The National Science Foundation, through its Intergovernmental Relations Science Program, is attempting to develop state and local capabilities to both assimilate science and technology and to be able to understand the need for and components of science policy. These efforts have worked particularly well in Pennsylvania. There is still a great need for intrastate sources of innovations responsive to state needs.

Section O: Universities and Public Service

"The University Option"--Milton U. Clauser, Director, Lincoln Laboratory, Professor of Aeronautics and Astronautics, Massachusetts Institute of Technology

It has now been several years since most of us could predict with certainty the national trend toward increased emphasis on public programs and decreased emphasis on space and defense. There still are those who devote their energies to persuasion for a change in priorities. The theme of this conference is, however, not on whether we should change, but on how we can manage the change, and, in particular, how science and technology can help.

In fact, we have been trying to get started on more effective use of national resources on public programs for a long enough time to know that by and large we are failing. I believe there is now sufficient consensus for the broad objective of emphasis on social development. In the President's recent Budget Message, the percentage of the national budget for defense has been decreased from 44 percent in FY69 to 37 percent in FY71, while the human resources programs have been increased from 34 percent in FY69 to 41 percent in FY71. Perhaps some of this is political bookkeeping, but with the restructuring and the time required for buildup, I believe this change is about as large as is manageable in a two-year period.

Unfortunately, at the next decision level, the priorities are not so precisely drawn. The large number of sessions and problems covered at this conference is an indication of the diffuse state of the national consensus. I would venture to predict that we will hear equally urgent appeals for major programs on air pollution, water pollution, solid waste, transportation, housing, crime reduction, health, education, fire protection, oceanography, new towns, and old towns. Do we really have the management, the manpower, and the fiscal resources required to tackle simultaneously all of these problems with the required vigor? I doubt it. However, I do believe that the public is beginning to develop a consensus. The Harris poll gives top priority to education, and pollution is a close second.

Another definite step being taken by the Nixon Administration is to shift the planning and management of many of the human resources programs to state and local governments. Federal aid to such governments will be $28 billion in 1971 and is doubling every five years. If we cannot push all needed and urgent programs with full energy and resources at once, it is going to be up to our local and state political leaders to exercise their leadership on priorities. It is appropriate that the responsibility be at this level, since the priorities will be different in different regions.

It has now become common to argue that the success of the space and ballistic missile programs was due to management by a single agency which could effectively direct the vast resources of the programs. This simple explanation overlooks the equally great successes of our agriculture and civil engineering programs which laid the foundation for making America the greatest agricultural and industrial nation in the world. At a time when we were still "an underdeveloped country," the land-grant colleges set out to develop agriculture, and to provide the means for building water supplies, railroads, mines, harbors, and roads. The distributed authority and action did not deter the states and their universities from accomplishments that rank alongside of those derived from centralized management today.

Another common argument has been over whether we need more or less research to solve some of our civil problems. I believe we need more of a different kind of research. My experience has shown the great value of bringing new systems concepts to a demonstrated state of usability, in order that leaders can intelligently decide whether they wish to invest major resources in a "deployment" to solve the problems for which they are responsible. For the sake of brevity and to avoid the ambiguous word "research," let us call this approach Option Demonstration.

In most of the recent federal public programs on social development, there was no attempt to develop and demonstrate options before large sums were committed. We now recognize that it was a mistake to make such large commitments on attractive but unevaluated approaches. In the Budget Message, reference is made to the "Nation's failing welfare system" and the majority of people seem to agree with this assessment. The failure of the Head Start program to show lasting developmental gains has now caused more emphasis to be placed on systematically testing and evaluating a variety of approaches to aid pre-school children. The National Center for Health Services Research and Development will now focus "on developing and evaluating new organizational structures for providing health care, and demonstrating new ways of using auxiliary health personnel to alleviate demands upon scarce professional resources." In housing, Operation Breakthrough has been designed to demonstrate the economic feasibility of high-volume production techniques. In air traffic control, the new approach will be to develop and demonstrate new options for airports and airways before ordering a complex array of equipment that may not work as a system.

However, care must be exercised in advocating more and more research. There is a large gap between individual research and a plausible solution to complex civil problems which can be used by planners, managers, or engineers. The workability of a complex combination of concepts can only be ascertained by bringing the combination (the system) to a credible stage of demonstration. Even in the Department of Defense, after nearly a decade of reliance on studies, research, and analyses, there is now a firm trend back to hardware prototype development.

In short, we cannot hold to a simple faith that basic research or studies will lead to solutions to our public problems, but we must require that the efficacy of new ideas and knowledge be demonstrated as a part of the system before we risk our funds and our future--just as the farmer made the experiment station prove the practicality of its notions.

About a century ago, we faced the great task of bringing vast new land to our use. There were railroads, mines, harbors, and water and sanitation systems to be built. The productive efforts of the great majority of people still had to be devoted to farming. Most of the universities stood aloof from the big job at hand. Their obligation was to educate men for leadership and letters. There were strong differences of opinion in the country as to whether this was the proper attitude and as to what the universities might be able to do to help a struggling nation.

The land-grant colleges and agricultural experiment stations helped bring the benefits of science and technology to the nation. Medical care and public health also are in debt to the American university. In the 19th century, American doctors were trained in a multitude of private schools. New knowledge was gained from practice. Toward the end of the century, a medical school was started at Johns Hopkins. The Flexner Report, in 1910, brought the old into sharp contrast with the new. The force of the Flexner Report quickly brought school accreditation and state licensing of practitioners. Within a decade, the university medical schools were rapidly displacing the private schools. The teaching hopsital which became a part of the university pattern was the means of bringing together education, research, and public service. Full credit must go to the universities and their faculties which initiated such a remarkable change in health care and in public health.

With this brief refresher on how universities have made effective contributions to major public problems in the past, it is possible to ask where and whether modern universities might be of assistance in the solution of today's problems. More of the responsibility for planning and management for today's domestic problems will rest with the states, and many universities are allied to the interests of their states. The universities are among the few places where social scientiests, humanists, engineers, and natural scientists have a common organizational bond, and this breadth of talent is certainly required to derive the needed understanding of our problems. History has shown that university experiment stations can work on diffuse problems under distributed authority.

I realize that in the complex social, political, and economic structure of the '70s, there are a number of areas where the university may have little help to offer, and science and technology may only be a secondary element in the solution. I would venture the opinion that manpower, crime reduction, and housing are in this category. I recognize that large computerized job banks are being developed, that technology will make marked progress on aids for vocational and job training, and that experimentation and analysis will be needed in the fields of housing and community development, but does not the main responsibility for the above tasks rest with government, industry, business, and finance?

On the other hand, in the fields of pollution, transportation, and health care, the chief obstacle is that we do not have a suitable and economic solution in mind. The concerted efforts of social scientists and engineers are needed to develop demonstrated options, so that government and industry can plan, manage, and implement public programs.

As an anticlimax to this pitch for university involvement in the solutions of today's public problems, I am going to raise the question as to whether or not today's university is willing and able to undertake the challenge if called. It should be remembered that a century ago the existing universities, for the most part, could not or would not accept the call. A wholly new set of universities had to be created. In the present political and economic climate, I believe there is little likelihood that still another set of universities could be created as was done by the Morrill Act in 1862.

Six months ago, I was optimistic about the possibility of the faculty and students turning their efforts to the problems to which this conference is addressed. I recognized the reticence of the older faculty to advocate that the university venture into major public service programs, but the students and younger faculty seemed anxious to become involved. Slowly, I have come to realize that their intention is to continue the old research pattern, but to convert from defense and space subjects to civilian subjects. Very few have shown interest in devoting their full professional energy to a goal-oriented effort of the scale needed for an option demonstration project.

I would suggest we assume that the universities will respond to the call and consider what are the order of priorities in New England and how can we join hands with groups in the universities to get started on the top priority regional problems.

Section O: Universities and Public Service

Chairman: John S. Burlew, Director, Connecticut Research Commission

Recommendations

1. Universities should create new institutional arrangements to deal with the application of science and technology to public programs.

2. Universities should recognize the contributions of faculty members who devote themselves to the problems of society by arranging for suitable criteria for appointment and promotion and by budgeting specific allocations of time for faculty to engage in these activities.

3. Universities in the course of carrying out their primary function of education should attempt to inculcate in their students a devotion to social activism.

4. State and local governments should provide funds to the universities for the support of appropriate projects dealing with public programs and for the continuing education of public employees in connection with scientific and technological innovations that apply to their jobs.

Dr. Owen Durgin, Associate Director, Resources Development Center, University of New Hampshire, spoke on the relevance of the American land-grant college concept to the problems facing American universities today. He was less optimistic than Dr. Clauser of the transferrability of this model, because university research had little to offer in the way of solutions. Also, for social problems, there is no clear objective around which university programs or research projects can be organized.

Discussion followed on the applicability of the land-grant model. Although inconclusive, the consensus was that universities did possess skills of importance in coping with the nation's problems, and that new institutional arrangements are needed to facilitate the employment of these talents.

The ethical implications of this broadened scope of university research was raised by Rod Wallace, a graduate engineering student at Columbia University. In agriculture the chain of technological advances generated by research land-grant colleges led not only to our country's increasing agricultural productiveness but to increases in rural migration to urban areas (particularly black farm hands and their families from the South). Also, the charge was made that the research currently being done at the University of California (Davis Campus) on the development of automated harvesters for all fruits and vegetables that are now being harvested by handpicking techniques was motivated by the desire to break up the union powers now being established by Caesar Chavez and his followers.

Dr. Wilson Tally, a representative from HEW, who was also a professor at the Davis Campus,opposed this view. The primary motivation between development of the harvester was to help provide food at prices within the means of most consumers. In his judgement, there were but three alternatives open to the growers of fruits. Either they can automate, employ hand-picking labor at a low cost, or quit. It is imperative that growers find some way to keep their harvesting costs down, because, if they don't, they will soon price themselves right out of the market.

Mr. Wallace countered by saying that it may not be up to the universities to make the decision for the farmers, and that perhaps the best alternative would be for the union and the growers to work out together the future plans for the industry.

Dr. Stephen Weinberg, a nuclear physicist at M.I.T., suggested that it is undemocratic for universities to unilaterally decide that certain technical research (i.e., that which might have some military applicability) should be avoided automatically, or, for that matter, that cherry-picking machine research should be similarly avoided. It is the responsibility of the university researchers to be aware of the "human questions" and the "social implications" involved in their research, and, further, it is their responsibility to make the public aware of these implications. It is not appropriate for researchers to make decisions that properly should be considered by a much wider segment of society.

Dr. Vernon Ozgrow, of the New York State Education Department, criticized the simplistic focus of the workgroup discussion. The workshops were charged with overlooking the myriad interactions among the specific problems mentioned throughout the discussion. To omit these interactions would ultimately lead to inadequate models, and "inadequate models lead to inadequate solutions."

Another question was raised about the clientele that universities would choose in research on societal problems. Would they serve the military? Large business interests? Large farming interests (as was charged in the case in the Davis research)?

Although many participants agreed on the need for greater university "involvement," there were no formal suggestions for structuring this new relationship. Was the "interface" between the universities and society to exist in the definition of problems, the implementation of solutions, or both? Dr. Durgin responded by saying that interface, in his use of the term, had to do with translation; that is, if the universities were to deal with societal problems in their research, they would need personnel who could translate these problems (as expressed by people outside of the university) into a manageable problem definition for researchers within the university. This translator (or "interfacer") should probably not look and sound like an academic, and he should probably be involved in the entire course of the research, from the time the problem is defined until the proposed solution is implemented.

Peter Pauling, University of Maine, described a project of the state of Maine that was far enough advanced to indicate the kinds of problems that universities might expect to encounter in establishing "interface" arrangements with the general public. The Maine program was initiated by the state legislature nearly eighteen months ago with an appropriation of $1.8 million. The money was to be spent on the establishment and operation of a center for the study of various urban problems. Thus far, five institutes have been created for law and government, human resources, computers and data processing, learning laboratory, and engineering.

One of the first tasks of the center was to conduct a survey with various public officials in the state in an effort to determine how much money and time was spent on evaluating and monitoring local, state, and federal programs operating in the state. The survey's results indicated that in fact very few resources were being devoted to this kind of governmental software.

The center had devoted considerable time to the task of creating an interface between the University of Maine and other groups and institutions outside the university. The results of these efforts have not been too promising. Much time was spent attempting to train professors and university task forces to work with community groups (such as local model cities boards). Most programs that have come out of these collective efforts (between the community groups and the interface personnel from the university) have failed to address the fundamental economic problems that are plaguing so many of our country's urban areas.

To counter this shortcoming, it was proposed that the center hire an accomplished urban economist to systematically evaluate the effects of locally conceived programs. It was suggested that the evaluator be given the rank of associate professor at the university, but the economics department was only willing to give the evaluator the status of a lecturer, which severely hampered the center's chances of getting the kind of man they needed for the job.

Two other aspects of university involvement were discussed. The first was that the involvement should not just include the social sciences but that it should encompass all of the departments in the *university*. Secondly, there was a suggestion for a particular kind of involvement: ". . . *a program of internship with an extramural faculty advisor to permit students to become acquainted with the problems of society of working in business, industry, and other ogranizations in the community*."

Robert McGarret, University of Massachusetts, observed that the relevance of university research to society's problems will continue to be slight so long as government funding agencies require discipline-oriented research. Under the current approach to funding, the "publish or perish" syndrome is simply being perpetuated in a "multi-university" environment. In Dr. McGarret's words: "We spend more time publishing than we do reading." The general demands by students for relevance and the recent shifts by the National Science Foundation in their funding policy are two favorable and influential trends away from the obsolete funding of discipline-oriented research.

Dr. McGarret was also disturbed by the situation in which faculty members were involved in consulting jobs that did not allow them to actively use their research findings. He felt that this type of "classified" funding constituted a fundamental violation of academic freedom for the dissemination of information.

Section P: Resources for State Manpower and Financing

"Utilization of Defense Scientists and Engineers for Civilian Problems"--
Hugh Folk, Professor of Economics and Labor and Industrial Relations,
University of Illinois, Urbana-Champaign

This paper is addressed primarily to the question of the extent to which defense workers made available by post-Vietnam cutbacks or strategic arms limitations can be utilized in the solution of civilian problems, and, incidentally, to the related but distinct question of the extent to which programs to deal with civilian problems might be expected to provide employment opportunities for displaced defense workers. The first question arises from the subject of this conference. To answer it we need to know if defense workers bring special skills and experience which might be especially useful for the solution of civilian problems and if suitable employees will be available at appropriate times on suitable terms.

The pattern of skills of defense workers suggests that the operatives, skilled workers, and clerical workers engaged in defense manufacturing industry can be expected to adjust to changes in defense demand adequately if appropriate offset programs are adopted. This is not to deny that specific groups of defense workers will suffer hardship. Many workers will have to accept substantial reductions in pay and others will have to move to new locations. Older workers are likely to have particular difficulties. Special difficulties in adjustment are more likely to occur among administrative and management personnel and scientists and engineers who are highly specialized in defense related activities. This is not to say that the latter groups are more likely to experience extended unemployment; rather that they are likely to undergo more extensive adjustments. Most important for our present purposes is the fact that professional and managerial personnel are much more likely to bring useful training and experience to civilian problem areas than are the skilled and semiskilled workers.

Defense Scientists and Engineers

Two-fifths of Vietnam-related employment is concentrated in aircraft, transportation services, and ordnance. Defense employment is proportionately insignificant except in manufacturing. In 1967, for instance, slightly over 10 percent of manufacturing employment was defense generated, or about 2 million workers. This was two-thirds of total nongovernment defense employment.

The reemployment experience of displaced defense workers will be influenced by their skills and adaptability. A large proportion of defense workers are highly educated and trained. A very large proportion are engineers and technicians, who have in recent years been in high demand. A large part of this demand is defense generated, and a large-scale cutback would sharply reduce the level of demand while the number of job seekers would be sharply increased. Employment of scientists and engineers has been growing more rapidly than total employment, but most of the growth after 1950 was for R & D employment, much of which was the result of government defense and space programs.

Defense workers are more educated than the civilian labor force as a whole. Together with their young average ages it is clear that most defense workers will be quite different from the displaced workers in the nondefense cases that have been studied.

According to a recent study by the Bureau of Labor Statistics in fiscal year 1967, about 16 percent of defense workers were professional and technical workers, in contrast to 13 of the general labor force. In 3 of 53 occupations studied more than one-fourth of the employees were in defense work: aeronautical engineers, airplane mechanics, and physicists. Almost one-fifth of all engineers were in defense with three-fifths of aeronautical engineers in defense. About one-fifth of electrical and electronic technicians and engineers and science technicians were in defense work.

Defense engineers were concentrated in aircraft and parts and electrical machinery, equipment, and supplies, two industries that would be especially hard hit by cutback.

Vietnam-generated defense employment of engineers has been estimated at about 43 thousand in a recent Arms Control and Disarmament Agency Study. Strategic weapons generated engineer employment was estimated at 63,000. Thus a defense cutback resulting either from ending Vietnam involvement or strategic weapons production would release enough engineers to meet between one and two years' ordinary growth in engineering demand. Those released through defense cutbacks would not be a cross-section of engineering employment. Disproportionately they will be electrical and aeronautical engineers. Moreover, layoffs are likely to be highly selective with respect to quality. Most studies have found that technical supervisors released engineers who were most expendable, regardless of age or experience. Defense firms are not likely to release those engineers who are perceived to be highly competent, and constitute the core of their special capacity for large-scale contract performance.

Much has been made of the supposed difficulties of defense engineers in transferring to commercial engineering. Engineers in one study believed that cost-consciousness, hostility of commercial engineering managers to defense workers, and different specialty requirements were obstacles to transfer to commercial engineering. Those engineers who had made the switch, however, thought it was easy to do. Managers were generally optimistic about transferability with respect to skills and attitudes, but were less optimistic about the capacity of commercial industry to absorb large numbers of defense engineers. Both the engineers themselves and the managers generally were in agreement that where retraining was required it should be in-house.

Shapero, Howell, and Tombaugh in another study concluded that:

> . . . top management personnel of some of the composite companies indicated that they perceive the defense R & D scientist and engineer as being high-performance-oriented, while nondefense industry requires a cost-orientation. Almost unanimously they expressed the opinion they they would not transfer their defense researchers to commercial work (and have not transferred them in the past). None of them appeared to focus on the difference in salaries between defense and nondefense R & D work as a barrier, though this may be a barrier in other types of companies and industries.[1]

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[1] Albert Shapero, Richard P. Howell, and James R. Tombaugh, An Exploratory Study of the Structure and Dynamics of the R & D Industry, R & D Studies Series, Menlo Park: Stanford Research Inst., June, 1964.

The reluctance of these employers to shift their own engineers to commercial work contrasts strongly with the experience of laid-off defense engineers. In a sample of 290 Boston area engineers who went to work in commercial jobs were laid-off defense engineers found to be generally older, less skilled, less educated, lower salaried, and less specialized than those who remained in defense work. Of those entering commercial work, 24 percent had lower salaries than before layoff while 41 percent had higher salaries. Similar results were found in a study of laid-off defense engineers and scientists in the San Francisco Bay area, except that those who shifted to non-defense work were younger on the average than those who did not shift.

Since the relatively less well-paid and less well-qualified job changers tended to make successful switches to commercial activities in both these samples, it seems reasonable to conclude that if the relatively better qualified defense engineers needed to make switches to commercial activities they would be able to, always assuming job openings were available. Employer reluctance to switch their own engineers to commerical activities within the firm is not supported by a similar reluctance of commercial employers to refuse to hire ex-defense engineers.

These findings support the position that defense engineers are flexible and adjust readily to civilian employment when it is available. Obviously engineers, especially young ones, are quite adaptable. Many aspire to careers which eventually will lead them outside of narrow technical areas anyway. The problem is not in the adaptability of the supply, but in the inadequacy of demand.

Quite simply, defense demand is engineering intensive, and almost no possible offsetting activity is engineering intensive. The practitioners in civilian problem areas will seldom be engineers.

The Systems Approach to Civilian Problems

Civilian problems for the purpose of this analysis include air and water pollution, solid waste disposal, environmental quality, recreation, housing and urban development, transportation, safety, education, health services, crime control, and welfare and income maintenance programs.

It is not possible to make a detailed occupational analysis for all of the current programs dealing with these problems. In general, however, the pattern of skills is fairly obvious and does not require detailed study. Except for pollution, housing, and transportation, the hardware engineering skills are not represented; and even in these activities the engineering skills required are largely in civil, mechanical, and chemical engineering, which are under-represented in defense engineering. Thus in terms of current operating demands there seems to be relatively little opportunity for displaced defense engineers in these areas.

The common characteristic of all these problems, however, is that there is widespread dissatisfaction with both the level of support for programs and with the program content. In no one of the problems does the solution lie in a simple multiplication of current efforts. The key question is, can research and development on these problems generate improved solutions? Any answer to this question is speculative. A common view is expressed in the statement, "A nation that can put man on the moon can solve its (x) problem" where x is variously any civilian problem. Those who think in these terms view the "systems approach" as a potential path to solving these civilian problems.

It is far too early for a definitive judgement on the applicability of systems approaches to social problems. The California projects have received enormous publicity, but have not been implemented.[2] In my judgement this is the severest criticism of their utility. Judged substantively, the studies are like the famous dog that played checkers. The wonder is not that the dog played well, but that he played at all, and the wonder is not that aerospace firms did reasonable jobs of analysis (although strikingly impractical to my mind) but that they were interested in doing the jobs at all.

At the time the California studies were undertaken there was widespread concern over a defense cutback. The concern of the state of California was obviously well founded, because a very large proportion of California employment is defense generated. If the state's aerospace capacity could be even partially diverted into civilian problem areas there would be benefits for the state's balance of trade position in the event of continued cutbacks.

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[2] For a brief review of the California studies, see Harold R. Walt, "The Four Aerospace Contracts: A Review of the California Experience," Applying Technology to Unmet Needs, Appendix Volume V, Technology and the American Economy, The Report of the Commission, Studies prepared for the National Commission on Technology, Automation, and Economic Progress, Washington, D.C.: Government Printing Office, 1966, pp. V-45 to V-73.

The aerospace firms which won the California contracts were buying into what they hoped might be a profitable activity. Obviously they were not interested in establishing themselves as social program consulting firms. Rather they viewed their systems capacity as extended beyond systems analysis to systems engineering and systems management. The information system proposed by Lockheed had 10-year costs of almost $100 million, a tidy sum even for an aerospace giant. Space-General's crime and delinquency program had 5-year costs of $121 million, and North American Aviation's proposed cost of the integrated transportation model alone was from $6 to 9 million.

Without examining the projects in detail it is worth noting that only if the contractors were involved in designing and developing the program they proposed would it be profitable for them to get involved, and it is precisely these activities that state and local government are not organized to permit. Political conditions require that state and local governments either place contracts with favored firms or that they administer the programs directly and benefit politically from the resulting employment. Why would a local government hand over a significant part of its economic power to generate political benefits to a California aerospace firm? Only in California would this be at all feasible politically.

Thus the concept of employing aerospace firms for systems analysis, systems engineering, and systems management is politically unrealistic in the extreme. The specific programs proposed in the studies seem to me to have ignored political realities as well.

Bold, technologically imaginative, and clear-thinking systems analyses of social problems have their place, I suppose, but radical social change is very seldom impressed on the system from without. The aerospace firms did their studies, published them, and that was that. This is not to say that the systems approach is inapplicable, but only that it will only be successful when it is integrated and accepted within the responsible government organization. The systems capacity that is required must be developed within government.

This is in fact occurring. PPBS is spreading among states and cities, and the systems approach to budgeting is obviously a prerequisite to systems approaches in operations. Federal pressures on states to justify grant-in-aid proposals have the same effect. Outside consultants are frequently used, but nearly always they adapt themselves to the political conditions which they find. It is precisely this capacity for political adaptation that the aerospace firms lack. They are adapted to a single political organization--the Pentagon, and the Pentagon is a jealous customer indeed.

Before dismissing the possiblity that aerospace firms might be useful in solving civilian problems altogether, however, it may be advisable to look at the total size of their systems capacities. Gilmore, Ryan, and Gould studied this question and concluded that within the aerospace industry there were about 500 systems managers in defense RDT&E, 1,000 conceptual systems analysts in defense R & D, and 10,000 systems engineers in defense R & D.[3] They concluded that very few of these are likely to become available for civilian sector work in the event of an arms cutback since they constitute the heart of the specialized managerial capacity of the aerospace firms.

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[3] John S. Gilmore, John J. Ryan, and William S. Gould, Defense Systems Resources in the Civil Sector: An Evolving Approach, An Uncertain Market, U. S. Arms Control and Disarmament Agency, Washington, D.C.: U. S. Government Printing Office, 1967, pp. 73-81.

These findings are hardly definitive, but they indicate that the aerospace industry's systems capacity is concentrated in large firms, that few systems people are likely to be diverted to civilian problems even in the event of a major cutback, that relatively few defense engineers have any particular expertise in systems approaches, and, in summary, that displaced defense engineers and scientists are unlikely to provide much of a resource for civilian problems.

Developing R & D and Systems Capacity for Civilian Problems

However sketchy the analysis of systems approaches to civilian problems was, however, it seems clear that R & D and systems approaches hold high hopes of offering improvements in our handling of civilian programs. Capacity for these approaches is unlikely to come from aerospace firms. In view of this, R & D and systems capacity must be generated within the civilian sector itself. This capacity is likely to be of several kinds: in-house, consulting, and systems management.

In-house systems capacity is already significant in government operations. Even in 1967, 25 states and 19 cities reported some systems capacity, and efforts have grown rapidly since then.[4] Total expenditures in 1966 by these governments exceeded $22 million, suggesting professional staffing of perhaps 1,000. Obviously state and local government already possess some systems capacity. Further enhancement of in-house capacity is unavoidable with the growth of program budgeting and grants for management of research and development. With research and development especially there is need for close coordination and control with operating programs at local and state levels. Few operating agencies in civilian problem areas today possess the capacity to design and utilize R & D programs even if they had them. If R & D funds are to be useful, management capacity must be developed in the agencies themselves.

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[4] Dennis W. Brezina and Louis Becker, "Highlights of the Systems Analysis Questionnaire," Scientific Manpower Utilization, Hearings, Special Committee on the Utilization of Scientific Manpower, Committee on Labor and Public Welfare, U.S. Senate, 90th Congress, 1st. sess., 1967, pp. 362-369.

Consulting firms have long served state and local governments, but they have typically been used for one-shot or special purpose studies. The idea of employing consultants on a continuing basis is quite new. There are already a large number of organizations ready to undertake such consulting relationships. The advantages of such relationships are considerable. The consultant is able to concentrate on his contractual objectives and not get drawn into day-to-day operations as in-house experts are. The contractor is not bound by the wage limitations and frequently ridiculous personnel requirements of civil service systems. Most notably, consultants can even discharge unsuitable workers. With a long-term relationship the consultant can develop expertise and specialized competence in the subjects with which he deals. For state and local government relationships there should also be enormous economies of scale. A job done for one agency generates experience and capacity for dealing with the similar problems of another agency. Thus it would be expected that consultants would specialize in rather narrow functional and program areas across governments rather than serving as general purpose consultants to all the programs of a single government. There are few important disadvantages to the employment of expert consultants. Although some who have dealt with governmental consultants view them as Townsend views management consultants (they borrow your watch to tell you what time it is and then walk off with your watch), such consultants have very real contributions to make. They are likely to be a most important communications channel. While their rates appear high, it is doubtful that they are any more expensive than an equivalent in-house group would be. At any rate, no local government will be able to develop the specialized expertise that is necessary to deal with all of the pressing social problems. They must hire outside experts, and the important question is not whether, but who.

Both states and federal government will have important influences on what kind of expert consulting capacity emerges. Grants to establish national or regional institutes or centers which provide basic research, applied research, and consultative services might be useful in getting full value out of research and development funds. One of the major problems is information flow, and centers which not only perform research but send out the teams that are designing and implementing programs are likely to do better research and better consulting than organizations that do one but not the other. If such centers were located in universities, of course, they would almost automatically become engaged in teaching graduate students, and thereby increase the supply of specialists available in the area.

With respect to systems management I foresee little opportunity for non-governmental organizations. The political risks of handing over to politically irresponsible agencies operating responsibilities for programs are considerable. Politicians are unlikely to give up the political power that comes with management of programs to organizations they cannot control. It is necessary, then, that systems management capacity be developed in government itself.

Regardless of the organizational forms that in-house systems and consulting capacity take, the occupational demands of state and local governments are likely to be difficult to fill adequately in the immediate future. What appears to be badly needed are persons with maturity, experience, and technical training. There are many persons in government who only lack the technical training. Perhaps the greatest contribution the aerospace industry could make to civilian problems would be to provide (together with nearby universities) intensive training in systems approaches for the government workers who must develop systems competence.

One becomes a systems analyst not by a formal course of study, but through experience, intelligence, and careful reading. Efforts to instill the systems approach in business schools, social science departments, and programs in public administration are already underway. But the sketchy training now available is no substitute for experience in doing systems analysis.

Section P: Resources for State Manpower and Financing

"State and Local Government Employment"--Abraham J. Berman, Chief Labor Statistician, New York State Department of Labor

During the 1958-68 decade, the fastest growing sector of employment has been state and local government. Nationally, employment at the state level grew by 72 percent and at the local level by 66 percent. This contrasts with a growth of 25 percent in federal employment and 29 percent in private employment. By 1968, about one in every seven jobs in the nonfarm economy was in state and local government. Similar growth can be expected in the next decade since the need for expanded government services at the local level has been increasing at a rate faster than the ability to meet them. This paper will focus on the manpower aspects of future needs, and will suggest some solutions for obtaining the personnel needed to accomplish some of the goals set forth by this conference.

A substantial growth took place during the 1958-68 decade in the field of education (a rise of 72 percent). One of the substantial accomplishments during this period was the growth in state government-operated institutions of higher education. Employment in this sector nationally grew by 141 percent. Among the non-education functions, only public welfare showed an above-average increase (136 percent). However, all sectors increased employment with the gains ranging from 14 percent for highways and government-run utilities to over 40 percent in hospitals, health, and police protection.

One of every three persons in the state and local government labor force is employed in technical administrative or professional work--compared to 1 in 10 in private industry. An additional expansion of at least 40 percent can be expected for these jobs in the next decade. The tremendous requirements for these jobs point up the acute manpower shortage currently facing the nation's state and local governments, especially in the engineering (sanitary, traffic, and civil) and health occupations.

Part of this need would exist even if there were no expansion in services. Many professionals and administrators entered their jobs in the 30's as young men and women and today after many years of capable service are retiring. Such devoted civil servants are practically impossible to replace and very little effort has been devoted to the planned training of younger replacements. The Civil Service merit system, originally aimed to do away with the sins of political patronage, has probably outlived its basic purpose. The proliferation of examinations which the candidate has to pass at each step up the ladder has repelled many of the more capable candidates. They feel that they can do a great deal better in private industry. Even when short recessions hit the private economy and available Civil Service jobs appear more attractive the abler candidates take them for a stopgap period and then leave. Turnover rates are quite high, ranging from 10 percent in Hartford to 54 percent in Atlanta among five large cities in a recent study. The rate in New York City was 15 percent; in Phoenix it was 12 percent, and in Chicago, 18 percent. If these figures are representative, the problem of retaining capable staff for the period required to train them in the skills needed to replace the retirees is indeed a serious one.

In New England, a recent study indicated that almost one in twelve budgeted positions for professionals, technicians, or administrators in state government were vacant in 1968. In Maine, the ratio was one in seven. Almost one in five of medical professional jobs were vacant and for social scientists, particularly urban planners, the situation was almost as bad. Although computers have come in to ease the routine burden of clerical operations, there were serious shortages of programmers (24.5 percent) and systems and management analysts (19.5 percent).

In addition to finding enough professional, administrative, and technical personnel, state and local agencies will also be looking for persons with new types of skills and knowledge, as technological innovations continue to affect the content of occupations. Rapid technological changes in computers, communications, education, pollution control, urban development and housing, and health are expected to create a demand for new abilities and to make obsolete some existing ones. Furthermore, the advance of technology when coupled with the rapid growth of new management tools will require that supervisors, administrators, managers, and executives be continually equipped with broad new knowledge and skills to keep them abreast of innovations. Finding, training, and retaining enough workers with the requisite skills will be a challenge, perhaps even greater than that of the past decade.

Some of the significant developments expected over the next decade can best be understood by examining recent developments, especially federal legislation. The legislation of the 1960's has already begun to affect state and local government expenditures and employment. Major federal legislation has authorized programs dealing with housing, health, welfare, education, transportation, social security, poverty, senior citizens, civil rights, and the handicapped. Changes in federal legislation which will affect state and local government expenditures and employment are imminent and there is no question concerning the need for additional federal funds to alleviate the revenue problems of many state and local governments.

The growth in state and local government during the next decade is not expected to be as rapid as in the past decade. Between 1968 and 1978 a growth of about 50 percent can be anticipated in contrast to the 68 percent growth that took place during the past decade. In terms of what can be seen today, all professional, administrative, and technical occupations will grow at a rate faster than the overall increases with the exception of elementary and secondary teachers and nurses.

What solutions are possible to ease state and local government manpower problems in the future:

1. An evaluation of pay scales and fringe benefits so that state and local governments would be competitive with private industry and the federal government. This is especially needed in some of the smaller states and cities where low salaries are a decided deterrent to the employment of needed professionals. Industries in recent years have greatly improved their fringe benefits

so that now one of the former major advantages of government employment no longer exists. (One area in which a great deal of useful progress can be made is in the granting of sabbatical leaves for work in other organizations or for further education.)

2. An active recruitment policy is needed so that college graduates become aware of the availability and advantages of government employment. This is particularly needed in the engineering, scientific, medical, and accounting occupational categories, where sizeable numbers of vacancies currently exist and threaten to become more serious in the future.

3. A revision of some of the archaic civil service rules and regulations. The time between the filing for an examination and offer of a job is much too long. By the time the job is offered, many of the best candidates have found other employment. A reexamination of the requirements for many jobs is needed and the greater use of technicians and para-professionals in performing the more routine duties of the professional is needed. This, however, should be done by reengineering the jobs so that it is done in a logical manner rather than in the present catch-as-catch-can method. A more realistic use in higher level work of our present crop of college graduates is called for.

4. Greater use could be made of internship programs or work-study programs, so that college students become familiar with government work and may be future recruits.

5. A determined effort should be made through tuition refund programs and time off, if needed, for employees in the lower echelons to obtain the education and skills needed for promotion.

The best recruits for higher grade positions should come from the existing supply of workers and an upgrading of their skills with automatic promotions where higher grade jobs are available would help in relieving some of the worst shortages.

6. State and local government should study and emulate the processes used by Big Business to satisfy their personnel needs. There are, of course, institutional rigidities within the civil service system which militate against the use of some private business methods, but others can certainly be utilized to ease job shortages.

7. States should form regional manpower councils to assist each other in recruiting scarce skills. These councils should not only service state governments but also local governments in their regions. These councils should also make projections of future needs and attempt to recruit candidates at an early stage for satisfying those needs which normal labor market processes would not meet. The need for such jobs as sanitary and traffic engineers and even the broader field of civil engineers, as well as urban planners and some specialized scientific and medical disciplines, will not be met by existing programs. Efforts should be made to encourage curricula in these fields in state institutions of higher education and to encourage students with scholarships, if need be, to take these courses.

8. It may be useful for professional workers to shift among various levels of government and even into related private industry without losing tenure in their permanent jobs. This would broaden their experience and allow them to perform more efficiently in their permanent jobs.

9. A study should be made of why high turnover rates exist and what can be done about them. Persons leaving the service should be asked these questions and policy decisions made to ameliorate this problem.

The above indicates some of the methods which can be utilized to ease the personnel shortage problem in state and local government. None of these by themselves will be a panacea. Several of them have been tried and have proved to be unsuccessful. There is a need for a greater use of modern management tools to reexamine and restructure the whole system. Unless this is done in the near future, and remedial measures instituted, the present problems of state and local government in performing their expanding functions will be severely limited and the sufferers will be the citizens of the communities involved.

Section R: Industry and Government

"Industry and Government"--Mason Haire, Professor of Management, Massachusetts Institute of Technology

One immediately thinks of a variety of possibilities--waste disposal, information systems, housing, and, indeed, a systems view itself. What kind of things account for this strange anomaly--on the one hand a pressing national need, and, on the other, high levels of relevant technology, but a failure of the two to come together?

I would like to sketch some of the problem under four headings--three dimensions of the problem and, hopefully, a step toward a solution. They are:

1. The problem of making a market.
2. Organizational issues between industry and government.
3. The money involved and how to manage it.
4. A research and development agenda and an outline of a mechanism to manage it.

The Problem of Making a Market

Some of the difficulties in bringing together technology and the cities seem to have the characteristics of straightforward marketing problems. It is very difficult for companies to identify their customers. Companies that sell, for example, sewer tile or fire engines know their customers and know the characteristics of the specifications their customers want. But high technology companies find difficulty in identifying and aggregating the market, and they fear encountering situations that seem to demand prototype, one-of-a-kind, or software solutions.

-- Most companies seem to be doing very little in an active way to solve this problem of the identification of the customer. In most cases, for example, the sales force is the regular industrial sales force. When salesmen are brought back to the company for training, the training is on company products and not on customer characteristics.

-- A good many companies have learned how to deal with the DOD as a customer and have developed skills, organizations, and people to do so. The disaggregated nature of the state and local market has made it harder to do the same thing. Generally, little attempt is made to meet this problem.

-- In rare cases companies have tried to develop a whole new posture and to enlist new people and new skills to tackle the problem.

-- Typically, company attitudes toward the recovery of developmental costs are traditional. They will only invest in the exploration of new problems to the extent that a market can be forecast to justify it. There are exceptional cases in which sizeable investments in both organizational and developmental innovation for dealing with state and local problems have been made without a clear vision of the possibility of recovering the investment.

The pluralism of suppliers unfortunately matches the pluralism of customers as a barrier to the adoption of technology. In high technology areas, the supply side of the market equation is equally diverse, disaggregated, and confusing. The industries offering new technology are not visible to cities as suppliers, and cities do not know where to turn. Who, seeking a city health system, would turn to an aerospace firm or a major electrical equipment manufacturer? Yet two such firms are active in the field of urban health. Another major electrical equipment manufacturer is interested in waste disposal, another aircraft firm in rodent control.

Unfortunately, a simple organization of the market will probably not solve the problem. For one thing, even if we identified the customer, it isn't clear that he has enough money to buy; it has been said that we can run cities better with the money we have, but we can't run them well with it. The problem clearly calls for a major recommitment of national resources.

-- Considerable case can be made for the argument that, in recent years, high technology industries have developed almost only where the federal government was the major customer. Space and defense are obvious examples. Even numerically controlled machine tools might have remained an intriguing possibility had the Air Force not committed itself to them. If the level of technology in urban affairs is to be raised, a similar kind of massive and dependable commitment to funds for development and purchase may be necessary.

Simple statements about the size of the market are clearly not going to do the job. The private sector experiences only frustration when it is constantly assured that there is a large market available but is unable to find it. The market must be differentiated, focused, identifiable, and effective in order to attract developmental effort to serve it.

Real precautions must be taken to be sure the user's needs are taken into consideration in making a market. We must avoid a situation where state and local governments must suppress some of their objectives to meet characteristics of the suppliers' products, production techniques, or level of technology. Citizens are already reeling from attempts to cope with the by-products of technological advance. If advanced technology is to be useful to the cities, the problems of the city must be prominently stated in the specifications or solution. We cannot afford the inadvertent by-products of solutions that flow mainly from exciting opportunities in products or processes.

We need two things: (1) aggregation of markets on both the supplier's and customer's side; and (2) a mechanism for defining the needs of state and local governments and the possibilities of industrial technology.

Organizational Issues Between Industry and Government

Another group of problems presents a barrier to the penetration of industrial technology into state and local government. There are differences between the two in organization, climate, and tradition. Often these differences are so large that the two parties speak to different purposes, in different images, and responding to different constraints.

-- Attitudes toward risk often differ widely. Companies may well not choose to risk development costs unless they can see a future market in which to amortize them; governments must often plunge into programs simply because they ought to be done. On the other hand, if a firm sees a future, there is a real reward both for the individual and for the organization in the successful management of risky innovation; government officials may get more reward for not being wrong than they do for being right.

-- Companies have time intervals defined by profit and loss statements; governments have intervals defined by elections. A kind of timeless continuity is a characteristic of the corporation, and its objectives stay relatively stable. Government's priorities, objectives, and strategies, as well as specific tactics, may change overnight with a change in office holder. The view of time from each of the two institutions is very different in terms of both its duration and the size of its pieces.

-- Companies like to think in terms of rational solutions. The model for them is a neat matrix that optimizes, say, production scheduling or inventory accumulation. (They often do not act this way, but they like to think this way.) Governments, in sharp contrast to this explicit, single, quantifiable dimension of objectives, are always painfully aware of having to maintain two or more often contradictory objectives simultaneously. Such a posture makes orderly optimizing difficult. What government, for instance, could afford to ask,"Will we use our cities to socialize an under-industrialized segment of the population or to maintain a stable work force? We must decide between them, because very different policies on housing, schooling, and the like flow from each." Even to pose such a question would be disruptive. Governments must muddle through without the benefit of easy maximizing devices.

-- Companies often complain that government units are not businesslike; governments often complain that companies are nothing but businesslike. The different objectives and springs of worth in the two have widely different consequences.

State and local governments often lack a climate or spirit, very difficult to define, which may well be of crucial importance to the adoption of technology. One senses that a kind of ability and willingness to innovate is a requisite for the transfer of technology in the private sector. There is a tendency for high technology firms to sell to high technology industries. Firms with the ability and willingness to innovate soak up advances; those without it find difficulty discovering the relevance of new possibilities. In a sense, the industry gets the technology it deserves. The same kind of thing is true in government units. Innovative suppliers are often not attracted to states and cities, because these levels of government lack the ability and the willingness to innovate, and the vicious circle commences. It is probably possible to break the continuous chain of cause and effect by deliberately--and somewhat artificially--intervening on both sides of the equation. Cities and states can be exposed to new possibilities in training programs and the like. Companies can be led to break their habits and make the effort to display high technology solutions even to relatively unwilling customers. Once a breakthrough occurs, extraordinary steps to publicize it may well help to freeze the new norm.

As a step in the process of developing a willingness to innovate, cities and states might attempt to change their view of themselves as customers. What is it they want to buy? Largely they seem to buy products--they buy bulldozers and computers and police cars. However, in their essential function they are primarily assemblers of other people's products. They deliver services. With respect to the services they deliver, the "make or buy" decision does not seem to be a frequent or paramount decision. Governments tend to buy components, assemble them, and sell (or, more euphemistically, provide) services. In fact, what the components are or who supplies them are of little concern as long as they do the job. If one focused on the possibility of contracting for the provision of service, it might endanger a higher order technological response. The concept of urban utilities providing services on a long-term basis in much the way that power utilities do might help to change the concept of the customer, shift the capital cost, and change the role of the technological supplier. Clearly this is being done in the contracting out of the operation of Job Training Centers and garbage disposal, but a broader espousal of the utility concept might well be useful. Under such a notion, a pooling of governmental units would not only--as now--give the leverage of pooled purchasing power, but would help focus the customer's essential need for services rather than products, and might elicit a technological response.

Money and Its Organization

An important cluster of difficulties centers around the issue of money. We must have a major recommitment of federal support, both in gross and in detail. The support needed stretches all the way from funding the construction of a research and development agenda, through funding development costs and demonstration projects, and into establishment of programs. The continuity of this process--from agenda to programs--is essential and must be stressed. Fragmentation and cross-purposes are already whittling away an initially inadequate level of support.

-- Present federal grant-in-aid programs may operate, inadvertently, to freeze out innovative technology. The tremendous excess of demand in the cities over the money supply in the grant-in-aid programs means a long waiting time and inadequate amounts per item. Neither of these factors leads to high-technology solutions. Furthermore, no preference is typically given for innovative remedies. Cities are forced back to patch-and-fix, temporary solutions. Moreover, this specificity of grant-in-aid programs often has the effect of overriding local priorities and leading the city to take advantage of what is possible instead of developing optimal technological solutions.

-- Piecemeal solutions to essentially systematic problems have the seeds of their own failure--and waste of precious scarce resources--in them. We are constantly in danger of painting over measles spots. Unless the questions asked span the whole system--

and remedies are directed to causes rather than symptoms, we can hope for little relief of the trouble and only growing social and political consequences. The interdependent systematic character of the social problem at the meeting point of industry and government calls for a comprehensive overview that stretches from agenda and possibilities through demonstration and experiment to programs.

A Research and Development Agenda

The primary requirement for the penetration of high technology into the urban problem is making a market. We need a broad-scale statement of the kind of things that need to be done on the one hand and the kinds of possibilities that exist on the other hand. We need a research and development agenda that will both set priorities and explore new solutions. We do not need a list of research possibilities of the sort that typically flows from the disciplinary refinements of the laboratory. These possibilities must be coupled to users' needs. A technology in search of a customer is fruitless in general. The example of companies with what seem to be advanced solutions vainly trying to peddle them through the market of cities is pathetic and dismaying in view of the national need.

The research and development agenda should represent a statement of possibilities that reaches into the future but is still closely coupled to the users' needs. But the agenda should not be overweighted by city-specific problems to be solved on a case-by-case basis. We need the generality of technological solutions intermixed with customers' needs, willingness, and ability to pay. The agenda needs to be tackled first at a fairly general level. It is quite possible that the more general model is easier to frame and more manageable than the single case. The city-by-city or state-by-state solution fostered by present fund management is liable to both the selectivity in variables of a specific case and the weighting of particulars in an individual history. Given the generalized model and agenda, the particular application will flow; the reverse is not necessarily true. Further, in order to guarantee any degree of even-handedness in matching state and local needs with technological possibilities, the issue needs to be elevated above the specific on both sides of the question.

A first step in meeting this need might well be the establishment of an institution whose mission would be to explore and develop such an agenda. Such an institution seems to be a realistic possibility. The Urban Institute has already been established as quasi-public organization designed for the exploration of cities' problems--a kind of "think tank" in the urban area. A parallel quasi-public organization --an urban technology corporation--might have as its mission providing the neutral middle ground between users' needs and the private sector's technological capabilities. Such an organization is conceivable and possible. It may well be that instead of proliferating organizations, this explicit mission should be added to an existing institution such as the Urban Institute. Whatever the organizational form of the solution, the responsibility for this overall statement of the research and development agenda is an essential part of the problem.

The cost of such an effort would certainly not be great against the scale either of current expenditures or the size of the problem. It is hard to take realistic guesses about what such an effort would cost at this stage, but in an eventual steady state of development, a research and development agenda program might cost in the neighborhood of $20 million a year. This would be on the order of 0.02 percent of the amount spent on urban services, broadly defined. A research and development agenda-setting of this size and a research and development program ten times as large do not seem out of scale with respect to the demands and potential of the problem.

Section R: Industry and Government

Chairman: Carroll Sheehan, Commissioner, Massachusetts Department of Commerce and Development

Recommendations

1. Government and industry must develop an increased social awareness. A realistic appreciation of what social objectives can be reached through the application of science and technology to domestic problems must also be developed. These objectives should be based on the needs of people and not projected profits.

2. Mechanisms for setting objectives, flexible standards, goals and for distributing funds for experimentation must be developed. These mechanisms might be based upon any of the following:

a. a mechanism for making a market--for aggregating consumers and producers;

b. demonstration projects funded by the federal government;

c. better use of these technical and professional organizations that exist and desire to become involved in developing new technological applications;

d. the exchange of people in industry and government and the university in order to create a better understanding of the needs and a more accurate level of expectation of the possibilities of applying science and technology to public problems; and

e. a mechanism for community and supra-community agencies or groups to establish goals and the diffusion of federal funds to these groups to enable them to meet their objectives.

Commissioner Sheehan

One of the greatest problems facing industry is educating state legislators so that they will understand the seriousness of the problems that currently confront American society. State legislators must be convinced of this or they will not make the necessary funds available. State government will have to play a greater part in the future. Industry, science, and technology will have to join with the administration of government to educate people to the problems and possibilities of applying science and technology to public needs.

Professor Mason Haire, Alfred P. Sloan School, M.I.T., then summarized the major points in his paper:

There are a number of barriers which prohibit the penetration of technology into the problem areas of federal, state, and local government. We have achieved a high level of technological capability and many of us are aware of the extreme levels of need among the people of the country for the kinds of benefits that innovative technology has to offer. Yet, the high technological potential and the high level of need have failed to come together. Why? If we are to answer this question, three very important things must be taken into account: (1) making a market; (2) the differences between the institutional structures of government and industry; and (3) the problems of money and money management. We have failed to make a market for new technology in the public sector. There are small disaggregated markets which cannot sustain the costs or handle the problems of creating levels and types of need sufficiently aggregated or capitalized to allow for the application of technology. We have in the past failed to be creative in our efforts to deal with the market for technology. There is a pluralism of customers and a pluralism of suppliers. We need to assemble both the suppliers and the customers if we are going to make a market for the application of technology to the problems of the public sector. In addition, we need some kind of mechanism for weighting the needs of different users and we need a device that will help to define both the needs and the technological possibilities. In addition, we must insure that this information flows freely between government and industry. Government and industry exhibit very different kinds of institutional behavior. One of the problems of bringing them together to address common concerns is the difference in the nature of the two institutions. First, there is a difference in the level of risk each is willing to take. In government, officials are rewarded for not being wrong. In industry one is rewarded for being right even if the risk taken might have been extreme. Second, there is a difference in the time horizon. Government changes radically in a relatively short period of time through the electoral process. Companies are timeless in that they like to think in high rational terms that optimize investments and profits. Personnel may change, but this policy will continue indefinitely. There are several additional barriers to a successful government-industry interface. Cities and states lack a willingness to accept technological advances, and since it seems that innovative customers attract innovative suppliers, that leaves government pretty much out of the picture. There is a need to broaden the process of farming out services. Industry and government need to be aware of the differences between them if they are to overcome these differences. In addition, government needs to provide more of a receptivity (a "seedbed") for innovation.

The third barrier to a successful application of technology to public policy problems is a lack of money and a lack of the ability to manage money. For example, governmental grant-in-aid programs are too small and too specific (narrowly defined) to allow for innovation. By their very nature, governmental aid programs destroy the possibility of achieving optimal solutions.

There is a need for a federal agenda for research and development, not just to present a list of very "glittering possibilities" but to carefully couple user needs and technological possibilities as quickly and as easily as possible. We need a creative agency to write this agenda; it may be a quasi-public development corporation or a branch of an existing agency such as Urban Institute.

Mr. Richard Lanning (United Aircraft Corporation) suggested that a mechanism was already available which could serve to set this research agenda. Private engineering societies, such as the American Institute of Astronautics and Aeronautics, might serve to provide this agenda. Other professional societies might be invited to work closely with state and local government to develop more localized agendas.

Mr. Richard Porter (General Electric Co.) pointed out that one way to overcome the problems of making a market would be to have industry and government exchange employees for periods of time. This is one way of finding out what the problems and possibilities really are. Industry, especially, should place some of its employees in governmental positions for short periods of time.

Professor Philip Klein (The Pennsylvania State University) asked whether Professor Haire meant to let the price system direct the allocation of resources in the public sector. Professor Klein pointed out that science's and technology's most successful efforts--the space program, for example--were effective when a specific goal, such as getting a man on the moon, was articulated. The goals or objectives of state and local governments have traditionally been vague and amorphous. The "customers" are not even clear about what it is they want. An important first step in the more efficient use of science and technology in government would be to state the specific objectives of government and then to see in what ways which industries might become involved.

Mr. Steven Georgia disagreed with Mr. Klein. Mr. Georgia suggested that even when goals are clear there is still the critical problem of implementation. More important than a clear statement of needs, goals, objectives is the willingness to take a risk to insure implementation. Government has been reluctant to take such risks. The benefits are never clear at the outset, but political costs involved in taking a risk usually are. In addition, companies are unwilling to commit themselves when there is no assurance that what will be produced will be utilized. There is a need for a demonstration program which will allow for risk taking and even for occasional failures on a small scale. At the present time there is no incentive for innovation. The federal government seems unable to pool sufficient demand to make innovation worth industry's while.

Mr. John Burlew (Director, Connecticut Research Commission) recommended that government make specific requests to specific industries. He cited the recent completion of a prototype device for measuring highway noise--this instrument determines which vehicles are making excessive noise. This was a case of a private laboratory taking up the challenge of a state government attempting to meet a specific need.

Mr. Richard Lanning expressed the feeling that there is always a tendency to say that a problem is a national problem and therefore it should be laid on the steps of the federal government. Setting goals centrally (or nationally) is inefficient. People wait locally while a federal bureaucracy attempts to set goals. Time is wasted. The federal government waits to be told what is feasible, but the smaller units of government have no idea of what they need or what is feasible because they haven't yet been told by the federal government. On the other hand we seem unable to aggregate blocks of demand on the local level. The more important the issue the less likely our decentralized political system is to agree on the goals. It seems that either way we have difficulty creating sufficient demand.

We are only able to create new markets if we impose requirements across the board by regulating--thereby insuring a market--or by clearly demonstrating that some technical improvement pays off over time. Pollution is an example. There is at present no incentive for industries to seek ways to abate pollution. We need regulations which would impose equal constraints on all industries--then the market for pollution abatement technology would be made. The only way to aggregate a market is to demonstrate that something has worked to someone else's advantage somewhere else.

Mr. Donald Sanders (Mayor, Westbrook, Maine) explained that his community is too small to indulge in experiments to apply new technology to public problems. He felt a need for a middle scale--a council of governments, for example--to undertake the setting of an agenda for technological research.

Section S: New Communities

"Institutional Control in New Community Development"--William S. Saslow, Joint Center for Urban Studies, Massachusetts Institute of Technology and Harvard University

At the very outset of the development of a city, provision must be made for certain essential utilities and public services, such as education, transportation, energy distribution, waste disposal, and so forth. As the city grows, its population changes and so does the world around it; new needs emerge, and new technological capabilities are developed. But, most often, old commitments for these services endure; to adapt them to new demands and new techniques is often so costly as to be prohibitive.

Ideally, initial plans for provision of these services should be designed to provide sufficient flexibility to meet the needs of future residents and to accommodate anticipated, but perhaps undefined, technological innovations.

This, indeed, is one of the great opportunities present in the undertaking of large-scale development projects on previously undeveloped land. Planned, or new, communities in which public services are specifically provided so as to facilitate technological or programmatic change can enable us to better accommodate continuing population increases and demands for those services.

With this opportunity in mind, this paper examines the institutional mechanisms created or proposed in three new town projects for the provision of two community public services: transportation and education. Specifically, these mechanisms are evaluated with respect to the following issues: (1) ability of the institutional body responsible for control of these services to achieve a proper balance between short-term requirements of present residents and long-term interests essential to the orderly growth of the community; (2) design factors and physical planning decisions which either inhibit or facilitate the ability of the community to respond appropriately to changes in technology and demand.

Brief case studies of institutional factors controlling the planning of these public services in three new communities are offered here to permit further exploration of these issues and potential conflicts. The towns are Milton Keynes, in England, Columbia, Maryland; and the Minnesota Experimental City (MXC).

MILTON KEYNES[1]

Milton Keynes is a proposed new city of 250,000 people to be located in North Buckinghamshire County, England, between London and Birmingham.

Administratively, the 22,000 acre area designated by the Ministry of Housing and Public Administration as the New City of Milton Keynes falls within four existing towns in Buckinghamshire County. Ultimate authority for approval of planning decisions within the county normally lies with the Buckinghamshire County

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[1] Proposals for Milton Keynes have been summarized from the following publications: Llewelyn-Davies, Weeks, Forestier-Walker & Bor, Milton Keynes: Interim Report, London, December 1968. Llewelyn-Davies, Richard; "New Cities--A British Example: Milton Keynes"; Science, Technology, and the Cities; U.S. House of Representatives Committee on Science and Astronautics; Washington, D.C., 1969.

Council, but responsibility for preparing and implementing the plan for the new city lies with the Milton Keynes Development Corporation, a public body created under the British New Towns Act by the Ministry of Housing and Local Government. Within this administrative framework the institutional mechanisms responsible for the provision of transportation and education are different.

Transportation

Responsibility for provision, management and operation of the public transportation system will lie with the Milton Keynes Development Corporation which, under the provisions of the New Towns Acts of 1946 and 1959, will retain its development controls until the city is essentially completed. At that time, the holdings of the Development Corporation will be transferred to the National Commission on New Towns or to local government units and the Corporation will be dissolved. As a creation of the Ministry of Housing and Local Government, the Corporation is effectively answerable only to that agency and not to the various levels of local and county government through which the future residents of Milton Keynes will express their political needs. The Corporation has only to "consult" these levels of government but is not bound by their attitudes.

As an instrument of public policy and program implementation, the Development Corporation for Milton Keynes is designed to be highly capable of reacting to new developments in transportation technologies and incorporating such developments into the public transit system with a minimum of local political interference. The advantages of this autonomy must be seen in relationship to two points. First, the history of Milton Keynes as a potential new town began not with the interim planning proposal completed last year but with the creation of a set of objectives for the Corporation derived from close cooperation between local, county and national agencies since 1962, when the original conception for a new town was suggested by the Buckinghamshire County Council. Thus, while the Corporation may act independently of local governments in decisions regarding transportation, the criteria by which such decisions will be made are a direct function of expressed local needs and attitudes. The cooperation between the Corporation and the region's public bodies is not likely to diminish since some other services are not under the control of the Corporation (e.g., education) and a check and balance system can be readily seen. As participants in the policy-making process of local government, the future residents of Milton Keynes will thus have an indirect, but nevertheless substantial, effect on decisions made by the Corporation.

The second point is that local participation in planning, however well-intentioned, is likely to be oriented toward short-term decisions and limited geographical scope. But investments in future transportation technologies, if and when warranted, will be considerable and will have long-term and geographically far-reaching implications. It is hard not to anticipate conflicts of judgement between local residents, whose concerns are immediate, and the Development Corporation, whose horizons must be far broader. In the resolution of potential conflicts, therefore, the Corporation has a degree of autonomy and control which can be very effective in protecting the broader and longer-range interests of the total development program for Milton Keynes.

Education

The plan for educational systems (from nursery school through higher education at a university level) for Milton Keynes is being developed by an education working party whose participants represent the Buckinghamshire County Council, the Department of Education and Science, the Development Corporation and its consultants. Determination of final educational policy, however, is the responsibility of the Education Committee of the County Council rather than that of the Development Corporation.

The most significant innovation in educational policy currently being considered by the Education Committee and the working party is the dissolution of geographical boundaries normally defining the area served by a school facility. Reinforcing this concept, the proposed grid layout of roads and transit should permit significant flexibility over time as the educational system evolves and as interaction among residents and facilities throughout the city increases. The fact that the "technologies" of the educational system (i.e., facilities and transit) are controlled by the Development Corporation, while education is technically the responsibility of the County Council, does not appear to constrain the comprehensive approach being pursued by the Development Corporation. Again, however, it must be recognized that the high degree of institutional cooperation in the planning for Milton Keynes is, in part, a function of the initiating process in which the County Council and smaller institutional units played major parts. Thus, a climate for effective administrative cooperation and public service control has been nurtured for seven or eight years and has resulted in the creation of many opportunities for innovation in the provision of educational services for the proposed new city.

COLUMBIA, MARYLAND[2]

Columbia was conceived and is being developed by James Rouse with the financial backing of the Connecticut General Life Insurance Company and other private sources. It has, at present, no substantial commitment of public resources through either federal or state development programs. Now in its third year of operations, Columbia has a population of about 8,000 people and is estimated to reach a level of 80,000 people by 1980, and an ultimate population of 120,000.

The "governing body" of Columbia is the Columbia Parks and Recreation Association (CPRA), a nonprofit taxpayer's association, in which all Columbia residents will have representation (through neighborhood associations) and to which they will pay annual dues. The creation of CPRA was based on the developers' desires to provide Columbia with an internal institutional mechanism capable of supplementing services provided by its public governing body, the Howard County Metropolitan Commission, whose jurisdiction extends beyond Columbia to include the whole of Howard County. In addition to this supplemental role, the Columbia Association has been designed to serve as the major controlling institution for development of public facilities through the period of the new town's development. Its function in this role is to ensure continuity of and adherence to the long-range objectives of the total development program as well as responsiveness to the changing needs of a growing population. With particular emphasis on the achievement of Columbia's long-range goals, CPRA is intended to be primarily an instrument of the developers until the plan for the city is substantially complete (as measured by CPRA's ability to adequately service debt with revenues from its assessable base). At that time, representation of the local population will be shifted to a majority share of voting control in the Association's activities.

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[2] Details on the plan for Columbia and the current status of the city's development were summarized from recent discussions with personnel from the staff of the Rouse Company and from numerous articles and publications as well as materials prepared at the Harvard Business School. The documents used most extensively were the following: Apgar, Mahlon, IV, "Systems Management in the New City: Columbia, Maryland" (unpublished), Harvard Program on Technology and Society, Cambridge, 1969; Howard Research and Development Corporation, The General Plan and Development Program for the New Town of Columbia, Maryland, Columbia, 1965; Jencks, Christopher, "Educational Programs for a New Community" (unpublished), Institute for Policy Studies, Washington, D.C., 1964.

It is this division of control, designed to serve the long-run interests of present and future Columbia residents, which has created an unanticipated problem presently faced by the developers. In its efforts to achieve a delicate balance between the short-run needs of present residents and the long-run interests of the total development plan, the Rouse Company underestimated the degree to which the early residents (now representing about 10 percent of the projected population for 1980) would want to assume active roles in decisions affecting the future of their community. Certainly, the structure of the Columbia Association was never intended to inhibit participation in decision-making by even the earliest residents, but the balance of power, weighted heavily toward the developers' interests (which are seen by the developers as consistent with objectives for the new community's growth), has been an irritant to much of Columbia's present population. Responding to continual demands by these residents, the Association has agreed to limited concessions designed to increase their participation in the Association's activities. While the original community participation scheme (and timetable) may be altered, it seems unlikely that the autonomy of the Association will be reduced to the point where its effectiveness as a development control mechanism will be appreciably diminished.

Transportation

The development plan for Columbia, as for Milton Keynes, reflects a strong orientation toward an automobile based transportation network. The road infrastructure has been designed with an eye toward future capacities which far exceed those required during the development period. At the same time, the provision of public transportation in Columbia is also being undertaken with an eye toward the future. The present public transportation network in Columbia is a minibus system whose vehicles seat about 20 people. Utilizing its own roadway, which is closed to private vehicles, the system allows unimpeded movement between destination points along its routes. Of equal importance, the effective reservation of rights-of-way, which presently accommodate the system's buses, will enable Columbia to transform its system as new technologies are available (and feasible) without major disruption of other community services.

Whatever the modes or technical components of future public transit networks, the operation and management of the system are expected to remain under the control of the Columbia Parks and Recreation Association. The Association's political and, to some extent, financial autonomy should permit a rapid and rational response to opportunities for incorporation of technological innovations. As presently structured, the Columbia Association seems capable of effectively balancing its autonomy with political determinants of decisions arising from current economic and social needs. This balance will be crucial in the Association's ability to effectively utilize the inherent flexibility of its transportation infrastructure.

Education

The plan for education in Columbia was developed from proposals made by the developers to the Howard County Board of Education, which has the responsibility for building and operating all schools within the county. Alternative plans for differentiating Columbia's system from the county system were explored by consultants to the developers but amended because of political opposition (both anticipated and encountered) from county officials and citizen groups. Thus, while the school system in Columbia is operated by the County Board of Education, the educational plan was worked out through extensive negotiations which resulted in approval by the Board of most of the final proposals (e.g., school locations, size, etc.) put forth by the developers. In some cases, such as the division of levels between primary and secondary education, proposals initiated by the developers have been adopted, in whole or in part, on a county-wide basis.

The structure of the educational system for Columbia bears a direct relationship to the evolving physical form of the city. Indeed, the size and location of the city's villages and neighborhoods correspond almost directly to the size and placement of schools. The high degree to which education is integrated into the total scope of community activities can be seen by the location of school facilities within the neighborhood and village centers where most community activities are concentrated. At the same time, however, the determination of school size, neighborhood size, road and walkway patterns from an integrated planning program has resulted in a relatively static educational structure for the community, whose ability to respond to innovations in educational thought may be inhibited.

A further constraint on the flexibility of Columbia's school system is, of course, the need for county-wide agreement on changes in educational policy. What may look like a positive innovation for Columbia may be perceived by other county residents as detrimental to their own local interests. The issue of school size is one example in which the developers deferred to the attitudes of the County Board of Education. It was originally hoped that considerable experimentation with smaller, more dispersed schools would be possible as the new town evolved, but anticipated opposition by the Board of Education led the educational consultants to propose a more traditional, and more rigid, educational plan.

What surfaced during the planning stage and what will probably surface in the future in Columbia and in other new towns are the critical issues of centralized vs. local control of schools and traditional vs. experimental educational policies. The necessity for incorporating Columbia's school system into the Howard County system, moreover, adds an additional layer of institutional responsibility which, by representing constituencies outside Columbia, may not be sufficiently responsive to the changing needs of the new town's growing population. In addition, unlike the Columbia Association, which is an effective protector of Columbia's long-run goals, there is little incentive for the county Board of Education, responsible exclusively to its present constituency, to adopt an equally long-range planning horizon.

MINNESOTA EXPERIMENTAL CITY (MXC)[3]

The Minnesota Experimental City, a proposed new city of 250,000 people, is projected to be built on a site (not yet finally determined) in Minnesota. Funded by both public grants and private contributions, Phase I of this comprehensive proposal was completed last year at the University of Minnesota. MXC has received considerable attention for its anticipated use of highly advanced mechanical and technical systems. Among those systems being contemplated is an easily accessible subsurface tunnel complex which would house all utilities and distribution lines and, perhaps, include conveyor or trucking facilities for delivery of goods and mail. An additional proposed innovation is the enclosure of a substantial area (if not the entire city) within a climate-controlled geodesic dome.

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[3] Background information for the MXC project was taken from the five published volumes which record the activities undertaken (continued)

As of May 1969, which marked the completion of the first phase of study for MXC, few concrete decisions had been reached on approaches to be followed when (and if) the project reaches the development stage. However, in the course of exploring an enormous range of alternatives for eventual incorporation into a development program, many ideas have emerged from the study which are appropriate to the discussion here. Perhaps the most pertinent conclusion expressed in the Phase I Progress Report is that the three long-term functions of planning, developing and administering the city can best be accomplished by an MXC Corporation made up of individuals representing both public and private interests having a stake in the city's realization. Although the quasi-public corporation would be self-governing through the development period, it would be phased out over time in favor of a permanent governing structure.

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[3] (continued) during the project's first phase. The summary volume contains most of the information cited here: University of Minnesota, Experimental City Project; The Minnesota Experimental City Progress Report, 2nd Edition; May 1969.

Transportation

If the Experimental City, in fact, reaches the development stage and maintains an emphasis on innovation and experimentation, certainly its transportation network will be a major area for such experimentation. Detailed studies are now underway exploring alternative intracity systems with particular emphasis on terminal and transfer facilities for people, goods and mail. In anticipation of integration of advanced and common technological systems, the work to date has emphasized the need for a highly centralized management and control mechanism for transportation services. The objective of the controlling mechanism would be to achieve a rational balance among expenditures for plant and vehicles as the demands on the transportation network increase with the city's growth.

Unlike the Milton Keynes Development Corporation and the Columbia Parks and Recreation Association, which have been designed as relatively autonomous bodies, the MXC Corporation is envisioned as an entity representing the coordination and participation of many interest groups. As a project specifically designed with an orientation toward social as well as technological experimentation, rather than as the solution to a relatively well-defined set of practical objectives (i.e., land development in Columbia, population dispersion in Milton Keynes), there are likely to be many critical questions unanswered during initial development. Much may be gained by building a city on these ambitious premises; but, there may be an inherent danger in creating a control mechanism responsible to many and varied interest groups and which, at the same time, must be both quickly responsive to opportunities for innovation and farsighted in its evaluation of long-term benefits to be gained from short-term decisions.

Education

There exists as yet no design for an MXC educational system. The educational workshop sessions held during Phase I of the study have, however, begun to identify several factors which are likely to determine the nature of the system ultimately designed. Of particular interest is an attitude toward the proposed new city as a "learning society" in which the concept of the student is broadened to include all residents who wish to take part in learning activities. In addition, the city itself is recognized as the "raw material" for the educational curriculum.

Anticipating the existence of institutional barriers in the forms of tradition, legislation, sources of financing and educational standards, the MXC proposal emphasizes the need for close cooperation between the planners of the city and public agencies responsible for education, particularly those at the state level. The proposal also anticipates that programmatic control of the educational system will, in all likelihood, be the responsibility of state and local agencies other than the MXC Corporation.

It is interesting to note that the degree of coordination required between planning for education and transportation must be particularly high if the new city is to reach its goal as a "learning society." However, little attention has so far been directed toward the possibilities for integration of the control mechanisms for these two services. On the contrary, in suggesting that educational control will remain in the hands of established agencies, it appears that the MXC study team has failed to recognize the increased opportunities for a better educational system which might accrue from creating a new agency--one which is disposed toward experimentation and which is, at least, compatible with the institution (i.e., MXC Corporation) controlling other city services, particularly transportation.

CONCLUSIONS

The history of new town development, particularly in Great Britain and Europe, has been marked by the evolution, with varying degrees of success, of institutions whose function is the control of large-scale development programs. Even in the United States, where public assistance for new community development has been virtually nonexistent since World War II, these institutions, such as the Columbia Parks and Recreation Association, have assumed the responsibility for finding a proper balance between short- and long-term community goals in the provision of public services. To a considerable extent, the success of these institutions is dependent on their ability to control the planned integration of service systems in a manner which permits the community to respond effectively to technological and programmatic changes as it grows and as its peoples' needs change. It is this ability which is most difficult to incorporate in institutions, such as those discussed here, which maintain effective control over only some of these systems (e.g., transportation but not education).

Although there is sufficient precedent for the design of institutions capable of developing and building new towns in the United States, there is not sufficient precedent to assure that such institutions will allow us to fully realize the potential inherent in new communities for accommodating growth and change in a better way than our existing cities have done in the past. Effective institutional control of systems which are expected to change almost continuously cannot be adequately accomplished through most mechanisms presently available to our public policy makers or to private developers. Certainly the mechanisms created must be responsive and answerable to a wide range of vested interests, both public and private; but recognition that such responsibility extends to interests which cannot yet be identified, such as those of the future residents of a new community project, must act as a major consideration in finding the proper relationship between these mechanisms and the current political arena. My opinion is that we will achieve neither the degree of integration of services nor the degree of foresight necessary to make new communities work unless the institutions which control the provision of public services are, at least, well-coordinated or, at best, highly centralized, and reasonably autonomous. We have the means to build new communities, and we seem to be slowly reaching a point where we will have the will to include them in emerging public growth policies. However, we do not yet have the institutions capable of building them properly.

Section S: New Communities

"New Communities and the Northeast Region"--Richard S. Rosenbloom, Harvard University, Graduate School of Business Administration

Growth

During the decade of the sixties total population in the eight states of the Northeast Region grew by an average of 450,000 persons per year. Projections to 1985 prepared for the National Commission of Urban Problems indicate a continuance of that rate, with 80 percent of the growth located in the suburban rings of metropolitan areas. At that rate, each year the Region must build additional houses, schools, shops, offices, and factories for a population equivalent to one-half of Rhode Island--and provide the public services to maintain it. A continuation of recent trends will further accentuate racial separation: for all metropolitan areas in the Northeast the nonwhite population will be twice as large in 1985 as it was in 1960, but the percentage (19 percent) living outside the central cities will not increase; in contrast, by 1985, two out of three whites will live outside the central cities.[1]

Our limited resources are not well used by present methods of urbanization. Consider land, a uniquely limited resource. Prevailing patterns of growth increasingly come into conflict with the high cost and limited availability of land in metropolitan areas. The rate of consumption of land is prodigious; as presently used, about 1/6 acre of land is needed to accommodate each person added to the urban population.[2] That adds up to some 10 square miles each month within the Northeast. The result of demand pressures is inflation and a tendency to upgrade residential uses; in combination these price the average wage-earner out of the market. For the country as a whole, land costs have been rising more rapidly than any other component of housing costs and now account for one-fifth of the value of new single-family homes. Between 1950 and 1967, while consumer prices rose 40 percent, the average price of FHA insured single-family homes more than doubled and the average cost of land for those homes quadrupled.

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[1] Patricia Leavey Hodge and Philip M. Hauser, The Challenge of America's Metropolitan Population Outlook, 1960 to 1985 (New York, Frederick A. Praeger, 1968). See especially Tables II-1 and III-5.

Superimposed on the natural limits to the availability of land are legal constraints. A study by the Regional Plan Association[3] identified more than 500 zoning jurisdictions inside the New York metropolitan region, an area of 12,750 square miles covering 31 counties in New York, New Jersey, and Connecticut. Within that area in 1960, 90 percent of the vacant land outside New York City was zoned for residential use, of which 99.6 percent was zoned for single-family housing only. Almost half of that land was restricted to housing on lots of one acre or more. If there is no change in those zoning restrictions, available land in the New York metropolitan region will not suffice for the growth in population expected by 1985.

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[2] This is the national rate suggested by the Davidoff-Gold study for the Kaiser Committee (A Decent Home, Report of the President's Committee on Urban Housing, Washington, D.C., U. S. Government Printing Office, 1968, p. 138). It corresponds to existing densities in the suburban areas surrounding New York City (4,017 persons/sq. mile) and Boston (3,444/sq mile) in 1960. (Six persons/acre is equal to 3840/sq. mile.)

[3] This is cited in A Decent Home (op. cit.), p. 140.

The wasteful use of land should be of special concern to governments in the Northeast. Open space for recreation is relatively scarce in the Region, by comparison with other parts of the United States. With increasing affluence, public demands on that space grow more rapidly than population, while the capacity to accommodate them may shrink. Furthermore, conservation of natural resources, like the wetlands, is directly threatened by unplanned growth.

There are other notable and serious inefficiencies imposed by present methods of urban growth. The public pays heavily, in the long run, for a pattern of settlement that forces a near-total reliance on the automobile for commuting and shopping. The family car is here to stay, but consideration of transport needs in community planning can reduce routine auto use and alleviate the costs of highway investment and environmental pollution which are concomitants of an automotive society.

Public services and utilities can be provided at lower costs, using present technologies, if planned in relation to the future needs of a whole community. Energy distribution, waste disposal, public transport, hospitals, libraries, and so forth, are expensive or impractical if based only on fractionated small-scale developments.

The price the public pays for these inefficiencies cannot be measured, but is nonetheless real; probably it is staggeringly large.

Although this burden is distributed unevenly over the population--and almost certainly bears little relation to the benefits different groups derive from urban growth--it affects all the Region's residents to some degree. To the extent that poorly managed growth imposes excessive long-term costs, we are mortgaging our future.

New Communities

Development of new communities offers a means to reduce the hidden costs and exploit the latent opportunities of continuing urban growth. New communities are of several kinds; they may be roughly classified as follows:

-- In-town developments, planned comprehensively on a larger than usual site within the central city;

-- Satellite towns, located near the central city, developed as a new pattern of suburbanization;

-- Special growth centers, beyond the suburban fringe, developed in anticipation of substantial future growth brought on by expansion of the metropolitan area, location of a major facility (e.g., jetport or electron accelerator), or growth of recreational uses;

-- New cities, located far from existing metropolitan centers, designed to provide self-sufficient alternative centers of growth.

All four types share certain common characteristics which differentiate them from conventional means for urban growth. Those characteristics are:

-- Significant scale, at least 1,000 acres and usually several times that amount;

-- Comprehensiveness: development is based on a deliberate plan that includes balanced amounts of nonresidential uses along with residential construction. Some degree of sufficiency in shopping, industry, recreation, and so forth is usually provided.

-- Central control, by a single authority that can sponsor preparation of the plan and oversee its faithful implementation.

Precedents

Is this a novel idea? Not at all; there are numerous precedents, some quite relevant and informative. Washington, D.C., Philadelphia, and other important cities were laid out on the basis of comprehensive plans created by farsighted founders in the Colonial era and the early days of the Republic. Unfortunately, the growth of these cities in the last century has shown little regard for the founders' vision.

The record of 20th century urbanization contains only scattered examples of community-building. There was the abortive effort to create a "garden city" at Radburn, New Jersey; the very successful development of Kingsport, Tennessee, wholly under private auspices; the federal greenbelt towns in Maryland, Ohio, and Wisconsin; various "company towns," including those hastily built by the federal government along with the new nuclear factories; the post-war experiment in Park Forest, Illinois; and the well-known Levittowns, launched on the crest of the suburban split-level boom.

The sixties saw a new flowering of the urge to build whole communities. An "uncomprehensive list" issued in 1968 by the American Institute of Architects identifies some three dozen American new towns in progress or completed during the decade. Most are intended to hold 20,000 to 100,000 residents when completed. All are private undertakings. Most are located in the sun belt of the south and west, where population growth has been the strongest and open space more plentiful. Yet, of all the new community ventures of the sixties, the best known, most studied, and most often cited are in the East. They are Reston, Virginia , and Columbia, Maryland.

Reston occupies a 7,400 acre site on the rolling Virginia countryside 18 miles west of Washington, D.C. Its visionary developer, Robert E. Simon, Jr., acquired 90 percent of the land in a single purchase (at $2,000 per acre) in 1961, persuaded the county Board of Supervisors to adopt a zoning ordinance for Residential Planned Communities based on average densities,[4] and embarked on the preparation of an innovative and sophisticated master plan. Construction began in 1963, the first residents moved in near the end of 1964, and an official dedication was held in May 1966. Reston won critical acclaim for its architecture and urban design, but land acquisition and start-up costs had imposed a staggering debt load--some $45 million --and development did not proceed rapidly enough to keep the venture solvent. In September 1967,control passed to the Gulf Oil Corporation, one of the original mortgage lenders. Since then, the pace of development has been brisk. In the 27 months ending in December 1969, 2,000 residential units were completed and population grew from 2,500 to 7,500. Thirty firms, employing 2,000 people, occupy sites in the industrial park. Some 40 percent of the housing in Reston is made up of rental units, including 200 units of federally-assisted moderate income housing with some two-bedroom apartments renting for $125.00 per month.

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[4] Robert E. Simon, Jr., "Modern Zoning for Reston," American County Government, May 1967.

Columbia is planned to provide homes, jobs, and a better way of life for 125,000 residents in the 1980's. Its current population exceeds 6,000. Columbia's location in the Washington-Baltimore corridor, midway between the two cities, gives it a stronger market, perhaps, than Reston has, and its financial management has been more prudent, although its debt is of comparable magnitude. Columbia, moreover, has pioneered in the development of new management approaches to planning and coordinating the myriad tasks involved in community building, including land acquisition (14,000 acres were bought on the open market over a 10-month period from 146 sellers, at an average cost of $1,500 per acre), detailed planning, construction of roads, utilities, and other infrastructure, and the development of residential, commercial, and industrial uses at a rate sufficient to support an average population growth of some 10,000 persons per year for more than a decade.

Columbia and Reston have demonstrated that the planned community can create attractive opportunities for prospective residents and industry. They have also demonstrated, paradoxically, that private enterprise alone cannot be expected to create planned new communities in the Northeast region. By definition, the new community requires the acquisition of a relatively large tract of land, the postponement of development until careful comprehensive planning can be completed, and a considerable investment to provide infrastructure and amenities in advance of economic need for them. In the Northeast Region the practicality of land acquisition on the open market is dubious. Even with land available, the private developer has few incentives for careful, comprehensive development. Time is money, and few are willing to tie up sums measured in tens of millions when risks are necessarily high and returns are slow to come in.

An alternative model for community-building, based in the public sector, is provided by the British experience in new town construction. To guide post-war rebuilding, Britain, between 1946 and 1948, gave firm planning powers to the councils of the larger cities and all counties, gave the Board of Trade control over the expansion and location of industry (and, later, offices as well), and provided for the establishment and financing of new town development corporations. Each development corporation has full authority to plan and build a town on a designated site. It may acquire property by compulsory purchase (eminent domain) and may borrow from the central government on 60-year notes to cover the full initial costs of development, including early operating deficits. Each corporation is governed by a policy board including representatives of local interests, including in all cases a senior member of the council of the nearby large city. The corporation typically will employ a full-time staff of some three hundred persons when development is in full swing. Fifteen new towns were begun in this way before 1960. They are now wholly or nearly completed and house a million persons. Another thirteen towns have been designated since 1962.

The success of the British new towns demonstrates the advantages of a public entity in providing the patient money, the sizeable site, and the concept. To be sure, it has been achieved in the framework of a comprehensive set of controls for national urban growth, including restrictions on the location of business activity, that are not likely to be feasible in the American setting. But the force of these other lessons still applies.[5]

Possibilities for the Northeast

Public decisions exert a great influence on patterns of land development in the Northeast Region of the United States, despite the dominance of private firms in the development process. The outcomes of the deceptively "natural" *laissez-faire* economic process are, in fact, substantially shaped by the actions of state and local governments. These actions include such matters as locational decisions for highways and universities, the allocation of educational resources within each state, the powers granted to localities to regulate land use, the ways in which those powers are exercised, the incentives for industrial development provided by states and localities, and so forth. *It is not a question of whether these* governments will shape the future pattern of urbanization, but how wisely.[6]

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[5] Richard Llewelyn-Davies, "New Cities--A British Example: Milton Keynes," *Science, Technology, and the Cities* (U. S. House of Representatives, Committee on Science and Astronautics, 1969) p. 53.

Present methods of influencing urban development are predominantly indirect or negative in character. That is, they flow from actions taken primarily (often exclusively) on the basis of other considerations, as in the case of the expansion of a public university, or from actions of a regulatory nature, as in the case of zoning or rent control. New community development offers one of the few tools by which the public sector can sensibly exert a direct and positive influence, initiating action, rather than just regulating other initiatives. Within our system of government, the power and the responsibility for such action clearly rest with the states.

There are some precedents, already, for positive instruments initiated by the Northeastern states. In 1968 New York created a statewide Urban Development Corporation (UDC) with powers to acquire land, issue bonds, and override local restrictions on land use and building design. The UDC has announced plans for development of a new community on a 2,100 acre site, already acquired, within the town of Lysander, near Syracuse. Over a ten-year period, a $250 million program, 80 percent of it from private investment, is expected to create a community with residences for 16,000 persons, jobs for more than 10,000, and appropriate transport, retail, recreational, education, and other facilities.

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[6] There are demographic similarities between Britain and the Northeast Region, as well as the obvious differences. The population of the United Kingdom is only 1/7 larger than that of the Northeast Region, and its average density is approximately the same as in that portion of the coastal megalopolis that includes southern New England, New Jersey, and the southeastern corners of New York and Pennsylvania.

New Jersey has created a commission to oversee the development of the Hackensack Meadowlands, a marshy tract slightly larger than Manhattan Island and located just across the Hudson from it.[7] The Meadowlands district includes property within the boundaries of 14 municipalities in two counties, but the commission will have the power to control its development. This is a long-term project; reclamation of the land will require several years and the development process should continue on to the year 2000 and beyond. A degree of local control is offered by the presence of six local citizens on the seven-man commission, and by giving a council composed of the mayors of all 14 communities the power to veto the master plan and all other plans and projects (subject to override by 5/7 of the commission).

It should be apparent that there are several models on which the Northeastern states could pattern the design of public institutions for the development of new communities. If such communities are to be built in the Region, the most essential need is for the creation in each state of some instrumentality by which their development can be initiated, planned, financed, and controlled. The differing social, economic, and political characteristics of each state may mean that different institutional models may be most suitable for each.

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[7] "Hackensack Meadows," Jersey Plans, Vol. XVII, No. 2, September 1968.

Whatever institutional model is endorsed, the result must be to combine within a single entity the following powers and characteristics:

1. Authority, subject to appropriate local participation and review, to designate areas for comprehensive planned development and to acquire land at a reasonable price.

2. The ability to finance the "front-end" investment with long-term money.

3. The technical competence and long-term perspective necessary to produce a comprehensive plan for development.

4. The continuity of management to oversee the implementation of development over a period of a decade or more.

The first two considerations argue for a public institution, but the last two suggest that it must be one that is shielded somewhat from the electoral process, enabling it to act in some ways like a private corporation. The role of the development corporation, furthermore, should be as a catalyst for development and not the sole developer. That is, the bulk of the managerial and financial resources for development should come from the private sector, as is planned, for example, in the Lysander project.

Recommendations

1. The Northeastern states (excepting New York) should act now to move toward the establishment of public institutions to facilitate development of new communities, with the goal of having one in being in each state by July 1971.

The first step, in each instance, would be to review the alternative means by which this can be done, so that the action taken will be appropriate to the needs of each state. The states should allow for considerable variety and flexibility, to meet the differing needs that already exist and to permit necessary adaptation to future developments.

Assuming the existence of some catalytic development corporation, specific new community projects might ensue from:

a. The initiative of a central city government, alone or in concert with one or more suburban jurisdictions, requesting that a particular site in the metropolitan area be developed.

b. The initiative of one or more contiguous towns, anticipating substantial growth (as in the Route 495 area of eastern Massachusetts) seeking to gain the resources to provide for necessary public investment and the power to control growth over a sizeable area.

c. The initiative of the corporation itself, identifying an opportunity.

2. The states should take appropriate steps to strengthen the role of new community development in improvement of the urban condition throughout the Region.

The location and concept of a new community should be related to over-all plans for its metropolitan region. Initially, this requires more effective collaboration by localities within metropolitan areas; ultimately more effective multistate mechanisms must be established.

A related step would be to create specific ties between the new community and nearby urban centers. For example, as noted already, the British provide a carefully balanced mixture of local participation and corporate autonomy in their new towns. New communities can be planned to provide direct relief to nearby large cities, for example, by providing relocation housing in connection with renewal and highway clearance. A "royalty" of 1 percent on all investment within new community districts could be imposed to create a trust fund to subsidize housing for families relocated in that fashion, or for other purposes beneficial to the older cities.

A further option is to use the new community to test and demonstrate social and technological innovations that might have wide relevance but that cannot be initiated as unproven concepts. The financial exigencies and other pressures of community development (even when done by public bodies) are likely to discourage all but the most modest experimentation with new technique.[8] A separate institution could be chartered for this purpose, empowered to act as entrepreneur and champion for these innovations, acquiring funding from public and private sources and managing their implementation in selected new towns. A regional organization could achieve significant economies and enhanced effectiveness in the following areas:

a. Providing technical and managerial assistance to state and local governments and new community development corporations in all aspects of the planning and implementation of new communities.

b. Providing a mechanism for the exchange of information between public and private entities involved in community development within the region as well as acquiring and disseminating relevant knowledge from research and experience outside the region.

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[8] See, for example, the companion case study by William Saslow.

c. Developing methods to plan, finance, and oversee social and technological experimentation in connection with the development of planned communities in the region.

d. To support the interests of the region's state and municipal governments at the federal level, by providing technical support and spokesmen on urban issues.

3. *To meet the needs outlined above, the eight states should jointly form an "Eastern Council for Urban Innovation" to provide technical and managerial assistance and information transfer for community development throughout the Region and to undertake a program of technological experimentation and development.*

The council could be supported initially by seed grants from the states and should seek more substantial financing from the federal government and foundations. It probably should operate primarily through contracts with universities and private groups, to give it greater flexibility and to build upon the Region's substantial intellectual resources.

Postscript

Will an aggressive program to facilitate new community development *solve* the Region's urban problems? Obviously, no. The problems are too large, too complex, too poorly understood, for any one policy or program to serve as a "solution." Even the most ambitious new community program for the Region could not keep pace with the demands of future growth, let alone begin to address the existing problems of the cities.[9]

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[9] For example, if ten new communities were to be initiated in the Region in each year for the next five years, and if all fifty were (continued)

On the other hand, a realistic program for the Region could account for 20 percent (or perhaps even more) of the population growth by the end of this decade and build the technological and organizational foundations for large scale efforts in the eighties. If the states are even to have that option by 1985, they must make the first commitments now. As one instrument, rather than a panacea, the new community alternative makes sense.

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[9] (continued) successful in reaching the development phase by 1980, assuming an average absorption rate of 1,000 families per year (an ambitious goal), they would account for about 200,000 people annually, considerably less than half the likely rate of population growth.

Section S: New Communities

Chairman: Irving Hand, Executive Director, Pennsylvania State Planning Board

Recommendations

1. An amalgam of public and private resources must be involved in the development of new communities.

2. States must play a role in promoting the development of new communities.

3. A greater understanding of the range of possible new communities must be obtained. New communities are not simply developments far from the city in open land. They may be in-town developments, planned comprehensively on a larger than usual site within the central city; satellite towns, located near the central city, developed as a new pattern of suburbanization; special growth centers, beyond the suburban fringe, developed in anticipation of substantial future growth brought on by expansion of a major facility, or growth of recreational uses; new cities, located far from existing metropolitan centers, designed to provide self-sufficient alternative centers of growth.

4. New communities should be developed as part of a total strategy for planning and development with relation to older cities and an entire region.

5. States should act now to formulate and adopt legislation authorizing the establishment of development corporations with powers

to acquire land and deal with problems of land use among other responsibilities.

Discussion focused on the problems which must be overcome in order to facilitate the development of new communities.

Financing

Private developers lack the capability and incentive to finance the enormous "front end" costs of land acquisition and infrastructure while having to wait years for the first positive cash flow. In the workshop there was much discussion about the ability of the private sector to finance new communities. Some members felt that since the private sector had financed some new communities--e.g., the Rouse Company in Columbia, Maryland--it ought to be possible to do it again and to make a new community a financially attractive investment. Professor Rosenbloom stated that James Rouse was an exceptional developer whose incredible performance was unlikely to be duplicated. Reston, Virginia, had been a financial failure until its recent acquisition by the Gulf Corporation rescued it. The innovative methods which need to be tried in new communities are not predictably financially viable.

In addition, the profit motive runs counter to the kind of cautious, comprehensive planning necessary to create a new community which meets the needs of the present local community and the early residents and yet maintains the flexibility to plan and provide for needs of future residents. When a large corporation analyzes the investment opportunities of a new community, it usually finds that the return on investment will be less than what is available from other alternatives. The laws of economics simply work against private industry building new communities. New towns built on land close to established urban centers, where the value of land would rise quickly, offered chances for a better return on investment, but had the disadvantages of having to overcome enormous jurisdictional problems and of providing limited opportunities for innovation. Methods must be found within the public sector to help the private sector overcome the problem of many years of negative cash flow created by the huge investments for land acquisition and infrastructure. Great Britain, in its most recent new town project, has established a goal of 50 percent public-50 percent private investment funds. This contrasts to earlier support from the government of 90 percent of the new town investment.

At present federal legislation (Title X of Housing Act) provides funds for land acquisition and the development of an infrastructure, but only limited funding is available. It was suggested that state higher education institutions be used as the economic focus of some new communities.

The Threat of the New Community to Existing Jurisdictions

In most areas in the northeast, any large land acquisition involves more than one local jurisdiction. In Pennsylvania, for example, there are over 5,000 local jurisdictional units. Acquisition of a substantial amount of land is extremely difficult to begin with, and use of that land may be severely limited. Once land is acquired, jurisdictional problems must be solved with regard to transportation, education, and all other elements in the governance of the new community. Most participants agreed that states must assume a role in the development of new communities. States are already making decisions which affect localities in deciding highway locations, educational facilities. They must continue this role in the development of new cities. Professor Rosenbloom pointed out that it was not a question of "whether the states would do it, but rather, how wisely." Precedents of states creating institutions to aid in the development of new communities were seen in New York in the Urban Development Corporation and in New Jersey in the development of the Hackensack Meadowlands. Legislation is in the formative stage in Pennsylvania. For state legislation for new community development to be effective it had to have strong powers, including the power of eminent domain. The power to override local zoning was seen as necessary, although it was recognized that this assertion of state power would be viewed as a threat to local "home-rule" and thus make more difficult harmonious state-local relationships. Participants felt that New York's UDC, with its "powers to acquire land, issue bonds, and override local restrictions on land use and building design," should be watched as it moves and evaluated carefully. There was some feeling that the first time such an authority used its override power the legislature might very well amend the legislation to remove that power. The necessity for working and planning at the initial stages of development with existing jurisdictions was brought out.

It was emphasized that planning for new communities should be undertaken as a part of a package of urban planning which involved the core city, the interspace, and the entire region. The issue of the new community being seen as diverting resources from the old cities or in competition with them was raised. It was pointed out that the relative magnitude of resources used in new communities was not so large that we need to worry. The construction of housing in new communities in the next decade will be only a few thousand units annually while new residential construction nationwide will be over a million units each year. But satellite communities should be planned in concert with the older city. New communities can be used in many ways as experimental labs for older cities--not as competitors for resources.

Mr. Hand emphasized this point by citing the sample of the Delaware Valley and Philadelphia. He felt it was impossible to deal with the core city problems without planning for urban housing elsewhere in the valley. The physical space in the core was too limiting. Building new cities was one method of helping to save old ones. In rural and semi-rural areas, involving local officials in the planning of such things as sewers and transportation makes it possible to allow entire regions to develop at the same time the new community is developing.

The interspace between the old city and the new is especially critical in the concept of regional planning. The interspace land probably represents 50-60 percent of the new construction which will take place so it is vitally important that it be considered. Organizational relationships must be developed which will facilitate planning between old and new jurisdictions. In planning for a new community the overall development of the region must be considered, although attempts to solve the problems of the entire region are unrealistically ambitious for the developers of new communities.

Marketing the New Community

Selling the concept of the new community is also important. It is necessary to break the pattern of suburban defensive zoning if future housing needs are to be met. Historically, having a home of one's own was part of the reason for coming to the new world. The F.H.A. still subsidizes this myth. A recent Gallup poll showed that, when asked where they would prefer to live, 6 percent of the respondents chose the cities, 17 percent the suburbs, and 40 percent rural areas. But as developments go up in rural areas these areas and the open space quickly disappear. Having a private home is retrogressive for future housing needs. People must be sold on the advantages of new communities--e.g., walk to stores, ride bikes in safety, large open spaces, etc.

Section T: Saving Old Towns

"Saving Old Cities"--Leo Molinaro, The American City Corporation

The very phrase "saving old towns" conjures up certain images of American cities that need to be clarified and challenged. There is a kind of despair hovering around those who work at or write about "saving old towns." Sometimes this despair is expressed in sentimental, nostalgic yearnings for the good old days and sometimes it is expressed in strident calls to the barricades to "fight blight" or to "wage war" against crime, poverty, or some other urban illness. In either case, there is a pervasive disbelief in the outcome--a kind of brave, deathbed vigil.

Many observers and commentators ask whether our nation can "save" our cities. I would turn the question around and ask whether our cities can "save" our nation. For it is in the cities that every revolution has been planned and carried out--beginning with our American Revolution and currently with the revolution for human rights, the consumer rebellion, the demands of the young, the poor, etc.

The crisis of our cities should be honestly confronted as a crisis in our entire value system. Challenges to our value system are most visible and painful in our urban areas because that is where there are enough people to develop constituencies, and because that is where our basic institutions are located that are being challenged to respond. We are in the flood stage of an urban revolution that reaches from architecture to sex.

Let us admit that the city has lost the initiative in dealing with the energies released by the process of urbanization. City government is completely absorbed with immediate, episodic, and chronic crises. It is constantly under siege from new demands and new interests and it has yet to find the handle for transforming these new demands and interests into a dynamic process that can move the debate to a new level.

In short, despite the mounting concern about the American city and the multiple attacks currently directed at its problems, we are not engaged in any city in the U. S. in a systematic attempt to discover what a city would be like that worked well for people who live in it--what it would cost to transform it, how its institutions would function, what the operating arithmetic might be of a city that was doing its job well.

The many urban programs that have been mounted are largely in response to crises and are directed at the symptoms of the city's troubles rather than at underlying causes. They are designed and launched in piecemeal fashion without relationship to one another or to any overall goal regarding the quality of life within the city.

Each is incomplete because it proceeds alone--independent of, and largely unrelated to, other programs directed at other conditions. We proceed as if housing, employment, education, health, transportation, and other processes and institutions were to operate in a city foredoomed to failure and frustration--as if each separate program is to do the best it can under conditions that are sure to be inefficient, inhuman, and destructive. We fight random battles in a war no one expects to win and, in fact, with no overall expectation of victory nor any strategy for achieving it.

The inevitable and recurring failures have produced a weariness about the city--a pervasive disbelief that we can really make the American city efficient and humane. This is neither a necessary nor rational state of mind. After two successful flights to the moon, I cannot resist the overworked analogy between organizing our energies and talents and resources for getting to the moon in ten years to tackling the task of redeeming our cities--or at least one city--in the same frame of mind, with the clear goal to make a city healty and workable; with conviction that it can be done; organized to face the problems, to design solutions, to plan and program the restructuring, reshaping, revitalizing process that will make the city work.

This change in state of mind from the disbelief that breeds timid, disconnected, incomplete, piecemeal thrusts at the city to conviction that the city can be transformed is essential to the kind of goal-setting and programming that must direct the city's efforts.

To bring about this change in state of mind throughout the country we need an image of a city that works:

-- an authentic and believable model of a new kind of old city in which the best that we know about education, health, employment, law enforcement, housing, community formation, transportation, and the other processes and institutions of life are simultaneously and systematically examined in creative and supportive relationship with one another;

-- the physical plan of which emerges from the reshaping of these processes and institutions to form healthy, dynamic new communities within the city;

-- the arithmetic of which has been carefully calculated to show capital costs, development schedule, new accessible base, income, and operating expenses. We have never seen a balance sheet and operating statement of a successful American city--only of cities that work badly.

A number of assumptions lie behind this mission.

1. The family unit is the best available basis for building personal and group unity of purpose, discovering individual talent and energy, and ultimately building a sense of community. Therefore, all delivery systems for health, education, shelter, employment, recreation, justice, communication, transportation, and government must be designed for maximum support of the healthy, functional family unit.

2. Local government is the best available basis for developing programs for the full utilization of human and material resources which respond to local needs and incorporate the unique characteristics of the people, their environment and history.

3. Local government must assume an entrepreneurial point of view about its own resources and about establishing goals for community development. From this point of view, local government can face demands for public services as an opportunity for building a better community rather than as problems and crises.

4. Local government will have to enter into new kinds of partnership with nongovernment groups ranging from the neighborhood level to the regional and even national level.

5. Both public and private capital formation must be increased and organized in new ways to make the most of available money, people, land, and institutions. This capital formation process requires a whole new framework of public and private accounts which rigorously relates expenditures to performance and performance to goals.

6. Planning and development activities, whether they are by public agencies or private developers, must be guided by the following principles:

Principle #1--In planning and developing an environment for a human community, goals must be established towards which the plan and program to realize the plan are directed. Such goals must include: (1) the full range of institutions required for healthy individual and family life; (2) respect for the land; (3) a return on public and private investments.

Principle #2--Every land-use and every human activity should be so located as to give support and strength to one another if their interrelationships are identified and used to greatest advantage.

Principle #3--Economic stability, growth, and profitability result from continuous, intelligent consideration of social and aesthetic concerns in every aspect of planning and development.

Principle #4--The distribution of social and economic differences determines whether they will feed into or upon the vitality of the whole community. Unbalanced distribution will produce inequities that feed upon the community; balanced and imaginative distribution will feed into community life and enrich it.

Principle #5--Plans and development programs persistently fail because they do not erect a vision big enough, exciting enough, and authentic enough to overcome community inertia. In reality, it is quicker, easier, and cheaper to do the big job that provides real answers than to undertake small, "safe" projects that provide only part of the answer. To avoid the usual frustrations and overcome the usual roadblocks, new proposals should aim at raising the level of discussion and negotiation so that new energies can be enlisted in a much better solution.

Principle #6--The process for planning and developing conditions for better community environment is a comprehensive process which cuts across all life-support systems and is accountable and accessible to both the "managers" and the "users" of these systems. Resources are available in America, and in every urban region, to permit the development of an environment of a much higher quality than presently exists, or is being currently constructed.

Principle #7--Currently every urban region is experiencing two kinds of undesirable growth--sprawl and ghettoization. To get balanced town and regional development, to provide equal access to all basic community services, it will be necessary to relate inner city developments to suburban development--old town plans to new town plans, development to redevelopment.

Principle #8--To carry out balanced development, large-scale (500-1,000 acres minimum) land development is necessary for the following reasons:

a. only in large-scale development can sufficient values be created to pay for some of the increased costs of a higher quality environment;

b. with large-scale development, you raise the level of visibility of specific projects, so they can convincingly demonstrate how this balance can be real;

c. by constructing large-scale quality environments, you can raise the level of expectancy of the people of the region for the total quality of the regional environment; this raises the level of discussion and stimulates imagination for considering new solutions and new techniques;

d. large-scale quality environments can have a desirable "spill-over" effect throughout the rest of the region.

If we set out to develop a program, based on these assumptions and principles, there are three basic questions that must guide our work:

1. What is the field of action--most particularly, what level of government and what laws determine the use of land, the tax structure, and regulations for construction and maintenance?

2. What are the institutionalized capacities for action--here we are trying to get at how community life services delivery systems are organized, who "owns" them, who "runs" them, who pays for them, how are they connected or how are they kept separate, how are goals set, how are results judged, how are changes made in the forms and functions of these institutions?

3. What additional vehicles for action are needed?

There is a growing realization that public and private mechanisms, in their current forms, are not adequate to the task of generating new proposals, let alone implementing them.

This inadequacy has been dramatically apparent in land development, which has become suburban sprawl, and in urban renewal, which had become so piecemeal that the Model Cities program was devised to take a broader approach. These results produce "policy sprawl," which reinforces the piecemeal, fragmented approach. Another direct result of this under-capacity to generate new programs of a magnitude to match the challenge is the consumer/user/citizen who has reached a state of constant unrest which breaks out in open rebellion from time to time.

The third major area of under-capacity is the lack of a research and prototype development activity focused squarely on the locality which must carry out investigations of the area's life support systems for the express purpose of producing prototype models for physical and social developments, based on economic and political realities. Private R & D groups can help, universities can help; but there remains the need for a clearly defined and organized capacity that researches and proposes and justifies its existence in its ability to produce information and proposals related directly to community development that are good enough to command a price from those public and private developers who would value such information and prototype proposals. This is not an ivory tower "think tank." There must be ways for the public to penetrate the research and proposal making.

Such a model would do three things:

1. Engage the people of a specific community in a process of setting goals that comprehend their needs and their notions of the good life.

2. Engage the institutions of the community in a process of re-defining and re-designing their objectives and their capacities to meet people's needs and support the good life.

3. Engage the planners, policy-makers, public and private developers in describing land uses and public and private actions required to carry out these land uses.

I would like to call attention to the process used in the planning and development of Columbia, Maryland, by the Rouse Company. I fully appreciate the differences between planning a new community on raw land and dealing with the realities of existing cities. Nevertheless there are some points that might be instructive, even when the translation from a new town to an old town might require taking an opposing or contrasting view.

This process is best described by Mr. Morton Hoppenfeld, Vice-President for Planning and Design of the Rouse Company, and a central participant in the development of Columbia. I would like to quote his description of the process.

> Columbia is a city growing in Howard County, Maryland, emerging from ideas to reality. The important idea in the development process is the attempt continually to see the whole in spite of the knowledge that a city is made of countless social and physical parts interacting in ways complex almost beyond description. At every stage from concept through building, we have tried to keep the parts in relation to each other. This simple idea

of the need systematically to understand the changing but critical relationship of all parts, is fundamental to the proper design of the city in both its physical setting and the family and institutional life within. At the same time, it is this very concept of wholeness which made Columbia possible to be built at all; in making it credible and attractive to one of the nation's leading investors, Connecticut General Life Insurance Company; and in making it credible and desirable to the citizens of Howard County, Maryland. . . .

We started traditionally to think in terms of designing a plan for the development of land and the buildings and spaces between them. To do this well required exploration into the living fabric of the city and soon resulted in planning, simultaneously with the land, for the creation of new institutions and the inter-relationships between all the city's life forces. The design process we followed required the most intensive knowledge and understanding of the physical environment, the discipline inherent in the slope of the land, soil conditions, tree preservation, keeping streams natural and creating lakes. In the gaining of this knowledge, design opportunities were revealed. The intent was to avoid preconception of shape of urban form end--instead, to let the design emerge from the given natural environment and other planned or existing conditions. Further design decisions required understanding of the human purposes to be served by the physical environment. As we sought to understand and describe desired relationships between individuals, families, and the institutions created to serve them, the best possible physical arrangements began to emerge. The Columbia General Plan is an expression of this process to translate the natural and social forces into physical development terms. . . .

In order to conceive of this city in the holistic terms described, we had first to find the human resources necessary. At the outset the Columbia planning team was made up of the typical set of "experts": planners, real estate developers, architects, and engineers. Each had his own set of biases about "a good city," based essentially on his limited experience and reading. None was really objectively or fully aware of the availability of data or enlightening conjecture on the interactions of people and the institutions of the city. Unwilling to act upon our own biases, we set out to gain knowledge of facts and insights into probabilities, to find a satisfactory technique for choosing among the infinite combinations of facilities and systems which would make up the "physical city" and germinate urban

> institutions and life styles. . . . The task was to bring . . . traditionally separate disciplines together and discover the richness of their interaction and the pertinence of their discoveries.
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> The idea emerged of creating a group from a cluster of individuals, each with "expertise" in generally defined areas such as education, health, recreation, and so forth. By their own admission, these were people without firm commitments to "a way of doing things" but fully aware of their respective fields and prepared to build upon them. Included in the group were advisors from the fields of government, family life, recreation, sociology, economics, education, health, psychology, housing, transportation, and communication. . . .
>
> Each function was addressed in turn, from individual and community health through libraries, active recreation, and the needs of home-bound young mothers, or children, and the aged. The individuals with "expertise" in a given area prepared to articulate "optimum" conditions. These papers served as grist for the interdisciplinary mill and traditional boundaries crumbled. . . . No consensus was sought during this process. It was in fact the ultimate responsibility of the principal planners and developers (also acting as members of the group) to put together the pieces of a plan and courses of action. . . . Difficult decisions between "optimum" goals and existing conditions continue to be made in the light shed by these sessions.
>
> A conscious decision was made afterward not to codify or publish the results of this process. A summary was attempted and it woefully failed to capture the essential value of the group meetings. It is impossible to describe the personal experience of the involved planners in thinking through and living with ideas subjected to the rigors of a systems concept where all parts are interrelated and dogmas and traditional "standards" are scrutinized. However, this experience still nourishes the decision-making process in Columbia. . . .
>
> The obvious conclusion from this is that the traditional approach of making a plan and then effectuating "the plan" is archaic. Plans need to be conceived as continually fluid and responsive to the feedback of operating agencies and development processes and opportunities. The feedback process is essential both to the quality of the plan and its fulfillment.

The essence of our planning technique is the continued amassing and refining of a reservoir of pertinent data and knowledge to be applied in the daily need for decision-making; even the postponement of a choice becomes significant in the process. The plan is at once as general and as specific as the situation demands. It can concurrently consist of the assignment of a broad category of possible activities (land uses) to a piece of land, the detail site plan of a development area, and the specific design of building and landscape.

There are few aspects of Columbia which, in separate form, have not been attempted elsewhere in the United States and, more often than not, rejected by communities not very different from Howard County. Time and time again, well-intended people have tried to introduce change in existing communities, whether it be in the form of multi-family housing, new industry, commercial facilities, group medical practice, or the sharing of a religious facility, and the proposals were and continue to be rejected. These efforts fail because they are isolated; Columbia succeeds because the efforts are interconnected, conceived and presented in the context of a whole new urban pattern.

Section T: Saving Old Towns

Chairman: LeRoy Jones, Commissioner, Connecticut Department of Community Affairs

Recommendations

1. Despite the avowed aim of the Conference, goals need to be worked through before it makes sense to introduce technology.

2. Establish means for all the sectors in the urban scene to participate in setting specific, important goals and objectives for city policy.

3. Find out how to set up more negotiating tables where diverse interests can meet to articulate and implement goals.

4. Use technology to create the needed information bases. The media have a responsibility to set the stage for urban improvement by bringing the full scope of the urban scene to the attention of all the actors.

5. Encourage voluntary regional associations, including youth representatives, universities, and industry as well as local governments, for confrontation, negotiation, planning and implementation.

6. Make major attempts to implement the "soft" sciences (in management and political science particularly) to create in public agencies and governments more receptive environments for "hard" technologies.

7. Undertake more cost/benefit analysis on land use in cities and devise means for capturing for public benefit the values

created by urban development, as in incentive assessments on property (comparable to the percentage of gross income demanded by mortgage lenders in development of commercial real estate).

Mr. Leo Molinaro, President, the American City Corporation, underscored the theme of his paper that a value base for "saving old cities " beyond preserving the central business district was required. He called for the development of an authentic and believable model of the old city, which reflected the best that was known about all important relationships of human activity to urbanization.

Discussion focused initially on whether developments in the truly "old" towns in Europe and other parts of the world had any applicability of their experience for American cities. The planning and coordination often found in German cities was said to reflect a culture of obedience and authoritarianism. American cities, in contrast, had developed much more diverse conditions with a more plural society, less consensus and no extensive culture of authoritarianism. Furthermore, Europe had yet to face the phenomenon of suburbanization facilitated by the automobile and highway systems in the U. S.

It was reported that the Ford Foundation is sponsoring a "Cities Project." Studies of London, Moscow, Tokyo and New York City will be made on a comparative basis by university participants; media participants will seek to depict the key findings and present them with maximum impact. Mr. Molinaro observed that technological change was being introduced in most cities through high pressure salesmanship. City governments were ill-equipped to evaluate the urban-oriented hardware (surveillance and alarm systems, slippery water, riot wagons, fancy information systems) being offered by private firms. The establishment of a central testing agency for such hardware items was recommended, on the model of the agricultural experiment stations. It was suggested, however, that an outside testing agency would not remedy the more fundamental problem of the quality of management in local government.

The Nature of the Problems of Cities

Two basic problems of the central cities were identified: (1) race--a black core surrounded by unconcerned whites; and (2) local government dependence upon state and federal sources for funds. Another approach to the problems of the cities rested on the following themes:

1. The American public is consumption-oriented and is conditioned to discard the central cities as well as such things as water resources and hard goods.

2. Education is the crux of the problem, because there is where values are formed and goals follow.

3. Revitalization of the cities requires new sets of values and goals.

Goals for Urban Society

With the issue of goals introduced, the discussion turned to questions of who is to set goals for urban society. Mayor Hugh Curran, Bridgeport, Connecticut, felt that the challenge is getting suburbs and central cities to work together on setting goals. Mr. Molinaro cited his firm's Hartford experience as an effort to formulate social goals. Three hundred individuals from within the Hartford metropolitan area were interviewed with the objective of determining what is on their agenda, what is not, and what the perceived impediments are. People were asked first, "If you had the choices, what would you most want?" The responses came out in such categories as life without serious illness, shelter that is comfortable for the family and socially accepted, unrestricted job choice, choice of the best schools, respect for privacy and so on. Then, "What changes would be required in order to achieve these desires?" The responses were diverse and confused: get rid of the Mayor, fire the City Council, look for a charismatic leader--the choices were easier to express than the mechanisms for change. Mr. Molinaro suggested that the broad desires of people need to be translated into very specific, important, challenging goals. For example, in the black and Puerto Rican area of North Hartford, the health of children was a recurring concern. Lead poisoning is a serious problem. A substantial fraction of the black and Puerto Rican young men develop hernias from attempting heavier work than their bodies can withstand; then they are practically unemployable for the rest of their lives. Mr. Molinaro offered an example of a specific social goal: that no child in a community reach the age of five years with a remediable medical condition.

Negotiating Tables

Mayor Curran questioned whether it was possible to have the residents of suburbs share the same goals as residents of the central city suburbs. Mr. Molinaro replied that there was a need to create more negotiating tables at which central city residents can find out what they have that suburbanites want and need and vice versa; then there will be a chance that their mutual needs can be worked out together. The central city riots of a few years ago were cited as an instance in which the importance of the central city to the businessmen with suburban residences was brought home.

Small Towns and Model Cities

Paul Lazarus suggested that a partial answer to the urban crisis might be a renewed interest in small towns and the positive potential they have. Although the proposals that former Secretary of Agriculture, Orville Freeman, advanced along this line were, in effect, hooted down, it was pointed out that HUD does now have a department devoted to small towns.

Section U: Regional Cooperation in the Use of Computers

"The San Gabriel Valley Municipal Data System"--Herbert Isaacs, Isaacs Associates

The San Gabriel Valley Municipal Data System (MDS) is a joint powers agency comprised of fourteen member cities located near the Los Angeles metropolitan area. Member cities, which spread across the counties, are predominantly of a suburban residential character, ranging in population from 11,000 to 90,000, with a total population of over 500,000, and an aggregate budget of about $55,000,000. The objective of MDS is to provide an operational vehicle for sharing modern computer technology and municipal government information systems. This case report describes the origins of MDS and the political, economic, and organizational problems of such an agency in accomplishing its overall objectives.

I. INITIATION

A major problem facing the small- to medium-sized city is the growing cost, complexity, and ineffectiveness of current manual and semiautomatic approaches to information processing. The state of the art in industrial and federal government uses of computer systems is easily ten years ahead of that seen today in most small cities. As the volume of activity increases, the inherent limitations of these manual systems have been increasingly evident in municipal governments' inability to cope with their expanding service requirements.

The standard response to this problem is for individual cities to consider upgrading their technology, especially by installing modern computer equipment. Unfortunately, there is a large fixed cost associated with development of particular applications of computers. Furthermore, the budgetary limitations of small cities prevent them from supporting computer equipment with the power and scope to solve many of their current problems. Typically, then, the small city settles for batch-processing service bureaus to accomplish repetitive applications such as utility billing and financial reporting. But the major control and management planning functions go unsatisfied.

Early in 1966, a small group of city managers began meeting as an EDP subcommittee of the East San Gabriel Valley Managers Association. This association meets periodically to discuss subjects of mutual interest. One of the subjects explored was the possibility of sharing the cost of both computer equipment and system development and programming on some mutually acceptable basis. In August 1966, the Association initiated a contract with the author to study the feasibility of multicity sharing of computer facilities.

The study was to determine if multicity sharing was technologically and economically feasible and, if so, what applications should be implemented according to what plan of action. The seeds of cooperation were evident even in this first step. In response to the recommendations of the city managers, the city councils of twenty cities shared the costs of the feasibility study, which was completed in January 1967.

Results of the Feasibility Study

The feasibility report explored some of the problems with present information handling practices in the cities. A major shortcoming is the compartmentalization of files and applications, resulting in a lack of regular data exchange across departments and little sharing of information between cities. Much needed information to support policy-making and planning is not currently being made available. Cities concentrate heavily on information of an audit nature and place little emphasis on providing information for management. Manual data processing is slow and error prone, especially in the rote tasks of file maintenance and calculations. Automatic data processing could perform these rote tasks more effectively, and free people to undertake the more meaningful tasks of recognition and decision-making.

The most serious drawback of the cities' present information processing systems is that they are really not systems at all. Rather, they consist of a set of different jobs that have grown up separately with essentially no relationship with each other. The result is each department's information costs more than necessary and some information of net value to all departments is not being collected. With present manual and semiautomatic methods, improvements could only be obtained by adding substantial numbers of additional personnel to the data processing staff of each city. Furthermore, some requirements, especially in planning and policy-making, are economically feasible only with modern computer technology.

The feasibility study also explored the costs presently being incurred for the major information applications in municipal government. A major portion of these costs would be displaced by a central computer service. Analysis of this "displaceable cost" resulted in a baseline of economic feasibility that could be compared with the cost of new proposed approaches.

Several alternative technological approaches were considered. There were two major variants, both of which proved to be economically feasible compared to the displaceable costs. One approach would be a typical batch-processing computer system. In such a system, the incoming information would be converted to machine-readable form either at the city or at some central location. All processing would occur at the central location and the results would be sent back by courier to the originating city.

The second major technological approach was a somewhat advanced concept for the time period of the study, 1966. A remote time-sharing computer system was postulated, with terminals for input and output located on city property and connected by phone lines to a central computer system. In effect, the consultant introduced some technical judgements of his own at this point.

Observation of the trends in data processing in industry and in the federal government seemed to indicate remote, on-line systems for large data processing applications were becoming the rule rather than the exception. With the decreasing costs of telecommunication equipment and large random-access disk memories, it seemed apparent that at the date the proposed system would finally be implemented, time-sharing would be the accepted technology of the day. Although the time-shared system's cost was slightly more than that of a batch-processing system, its advantages for a multiagency sharing requirement were significant. In sharing any batch-processing operation, a major operational difficulty is found in the priority of processing. Considering the political autonomy of the municipalities, this issue of priority potentially could be serious. In a time-sharing system, the processing is automatically interleaved, and the individual cities appear to have continuing control over the job stream. There are, of course, some scheduling problems associated with the large batch reports that must be produced at the central computer, but the majority of the computer processing in the time-sharing system is controlled from the remote terminal. It was felt that the on-line time-sharing systems provided the best compromise between the economies of centralization and scheduling requirements of the individual cities.

There was another consideration in the recommended approach concerning operational responsibility for the central system. One alternative available to the group of municipalities was to contract with an externally run service center. Such businesses have the advantage of being able to attract skilled operators and support personnel, and to retain them with long-term career path prospects. Municipal agencies have typically suffered from a lack of qualified personnel due to the inability to match both industry salaries and career-path potential.

A major consideration in the feasibility study results, however, was the requirement for integrated file systems and applications within cities, and the sharing of information among cities. The "software" component of the system must be especially designed to accomplish those shared file objectives. A private service bureau is at a disadvantage here because its software must be able to accommodate both the city applications and all its other customers in order to be economically productive. As a consequence, the costs for equivalent computer capability purchased from an outside vendor tend to be greater than those of a joint agency operating a system dedicated solely to its own needs. If one adds the normal profit margin required by a business, the difference in potential dollar cost is significant.

The joint municipal agency still needs to attract qualified staff to operate and maintain the system internally. This can only be accomplished by setting salary and benefits at a level competitive with industry. Such a recommendation was made to the ultimate joint powers agency and was accepted by them as an operating principle.

Applications and Implementation Plan

The selection of applications to be included in the first phase of the system development was mainly in response to an expression by the managers group. The system had to meet the immediate needs of the "bread-and-butter" applications in order to be politically salable to the respective councils. Thus, the four major applications included a comprehensive finance system, utility billing and accounting, police management statistics, and land use planning. The planning application and other overall management and policy-making support was to be accomplished through the introduction of generalized information management technology. This is computer software that provides a high-level "user language" to specify file content, file maintenance, and information retrieval, processing, and reporting. The generalized information management language is the tool by which the system adapts to changing needs for file content, input, and output.

The plan developed and presented in the feasibility study included a thirty-month development program to bring the central time-shared system into operation. This program included the preparation of bid specifications and selection of equipment, system design, computer programming, testing, training, and installation. In addition, there were some short-range recommendations for getting some experience with the time-sharing technology, particularly in the utility billing area. Several of the individual cities purchased services on a temporary basis while the overall system development was underway.

II. APPROVAL STAGE

The final report of the feasibility study was delivered in January 1967. A remarkably short time delay was experienced before formation of the joint powers agency. By September of 1967 eight cities had ratified a joint powers agency agreement and its bylaws. Before the end of the year a total of twelve cities had become members. The current membership is presently fourteen.

The success in forming this agency in such a short period of time is primarily due to the political sensitivity of the original city managers group. During the feasibility study, members of the councils were continually kept apprised of developments and results to date.

The basic obstacles that had to be overcome were threefold. In order for any city to join such an agency, there had to be the assurance that the ultimate service the agency would provide would be an improvement over present methods of doing business. The cost comparisons contained in the feasibility study went a long way to satisfy the basic questions of "what will we get and how much will it cost." Implicit in the what-will-we-get question is the requirement for understanding on the part of nontechnical but experienced and intelligent administrators that the new technology would really do the job. Some of the obstacles to this understanding in individual cases lay in past experiences with abortive attempts to introduce computers and related technology. A large share of the sales effort was devoted to communicating the concepts of the new technology and the experiences of other organizations in terms that related directly to the day-to-day experiences of the policy officials concerned.

A second set of obstacles was related to the nature of the joint agency itself. Considering the political autonomy of each municipality, their respective councils had to be convinced that they would have a voice in the control of the organization regardless of the city's size. Furthermore, there had to be an effective method of limiting the responsibility accepted by the agency on behalf of the cities. Thus, a major aspect of the bylaws included the approval chain for outside contracts, and adoption of the yearly budgets. A major point in the effective construction of MDS was the existence of a one-city/one-vote approach. Furthermore, the board members and alternates were required to be legislators rather than administrative staff. This guaranteed the continued interest and involvement of the council, rather than delegating the policy-making responsibility to administrators who later would have to explain their requests to detached councilmen.

The third set of obstacles was generally related to the availability of alternatives in a given city. For example, several cities in the original group that supported the feasibility study found themselves already committed to short-range alternatives such as the installation of tabulating equipment or a small computer. This precluded consideration of such a major investment program over a two- to three-year period. Generally speaking, it is difficult for an administrator to justify to his council any decision which requires his admitting that he made the wrong recommendation a year or two earlier. In point of fact, with the existing knowledge available at the time he made that decision, it may not have been a wrong one. However, he feels compelled to continue along a well-established line rather than face possible criticism for not having adequately researched the earlier decision. A related problem is the existence of certain personalities in cities who have established organizations with particular charters and to whom new alternatives seem to represent a threat. Because these individuals are usually in a position to influence decision-making, and because any new approach is always vulnerable to some form of rational critique, it is rare that such opposition can be overcome. In the case of MDS, the major approach to meeting such opposition is a well-prepared response on the merits of particular issues and a stressing of the advantages of the particular alternative over competing approaches.

III. THE PROCESS OF IMPLEMENTATION

In order to implement the thirty-month program proposed in the feasibility study, an investment of $575,000 was required. The Carnegie Corporation provided a grant of $210,000 to subsidize part of the software development. The remaining monies were budgeted over a three-year fiscal period and were contributed by the member cities on a formula based upon population and application use. A contract was undertaken with the consultant firm in July 1968, with a scheduled operational date for the system of January 15, 1971. Thus far, the project is essentially on schedule with, perhaps, a six-month slippage to be expected. This slippage is partially due to a slight delay in approval of the second phase of the contract because of the timing of budget adoption in the cities. It is primarily due to delays in production of programming specifications caused by a change in key contractor personnel on the project.

Review and Concurrence

The difficulties encountered in implementation are primarily associated with obtaining agreement on complex design issues from multiple users. The approach taken to resolving these difficulties has two aspects. The general approach is to embed a process of review and concurrence directly in the system design and development schedule. Documentation must be produced at a suitable level to communicate the design concepts to the appropriate user groups. This documentation serves as the vehicle for review and the reference for later implementation decisions.

The second aspect of the review and concurrence approach is to form committees of user specialists who participate in the design decision process itself as the development program proceeds. Thus, the finance directors of the cities comprise one user group; the police chiefs and their delegated staffs a second group; planning directors and their staffs a third; and city managers a fourth group. Each of these user groups meets periodically and contributes to specific design decisions identified by the consultants. Finally, the executive committee of the MDS board also constitutes a special review and concurrence policy body to approve the milestone products stemming from the development effort.

Interim Testing of the Concept

The time-sharing technology was actually tested on an interim basis by installing utility billing in five of the MDS cities. Operational experience in using remote, computer-connected typewriter terminals resulted in some valuable lessons, both positive and negative.

On the positive side, the technology lived up to its expectations in terms of effectiveness and economy of operation. Also, it was demonstrated that the current city clerical staffs could adapt quite easily to the remote time-sharing console, given the appropriate computer software and human engineering. The design principle followed is "if human error continually occurs in a repetitive pattern, the application software should be able to prevent that error." Thus, the utility billing system literally will not allow certain typical errors to be committed.

The major problems lay in the lack of adequate supervision both at the computer center and in some of the cities. Some of these problems were solved by changes in the computer software to provide better error control and data validation. But the requirements for detailed procedures at the computer center were much greater than originally expected.

Delays in Funding Decisions

A major difficulty faced by this three-fiscal-period program is the repeated delays in acceptance of municipal budgets and the decision to proceed to the next phase. The continual requirement to "resell" the individual cities in MDS on the continuation of this project has caused great waste of time and money in its successful completion. As new councils get elected, the decision is continually re-evaluated by the new personalities. There is no commitment to long-range planning on the part of the cities in terms of setting up a plan in appropriate blocks of time. The strategy to overcome this difficulty involves continual demonstrations and briefings on progress of the project. Many of these briefings are quite repetitive and detract from the manpower available to further the actual developmental effort.

IV. EVALUATION

The system is still under development but the technology has been demonstrated in several of the major applications. It has indeed lived up to expectations in terms of technical capability. The total project money made available, however, was marginal to begin with. It was judged by the project originators as the maximum amount that these small cities could support and still be able to proceed with a good chance of success. This minimum budget approach may affect the successful application of this technology.

The MDS experience highlights a general problem in dealing with city governments with respect to advance technology. The real cost of such technology typically experienced in industry and the federal government seems excessive to local government officials. The concept of risk capital is totally unheard of in municipal government. The idea that a research and development program could conceivably come up with a negative result is unthinkable.

Nevertheless, the existence of MDS as an organization does indicate that some progress is being made toward investment in innovation. If MDS is successful, there is no question that further innovation of this kind will be forthcoming. If MDS fails to live up to its expectations, however, the principle of shared computer processing in municipal government will probably experience a major setback.

In summary, the MDS development does provide several good lessons for future applications.

1. It is possible for autonomous municipal governments to join together in a political association that provides a compromise between sharing of resources and retention of political control. The author believes the one-city/one-vote approach is crucial to the success of such an entity. The formation of the board on the basis of political leadership rather than administrative staff is also a significant factor in retaining the awareness of the project at the appropriate political level.

2. The investment of a small amount of funds in preliminary cost effectiveness studies to explore feasibility of a new concept is crucial to the successful acceptance of the concept by the political leadership. The MDS feasibility study report was the major instrument in answering the "what-will-we-get-for-our-money" questions.

3. Considering the delays and normal development times for installing new technology, it is important that the level of technology chosen for implementation be a significant step in the state of the art. It is also important, however, that this step be one that is achievable within the budget dollars and time allocated. That is, demonstrated technology using off-the-shelf components must be employed.

4. The design approach utilizing review and concurrence committees is most effective in assuring that the result will be workable and accepted by the people that count, the users.

There are some problems in applying new technology which requires major changes in the way municipalities do business.

1. The implementation of such new systems requires personnel benefits and salaries that are competitive with industry.

2. The year-to-year budgeting cycle of most governments is a wasteful process, in both time and money. It should be replaced by careful review process culminating in block time and fund budgeting on special projects. In general, however, the MDS case is a positive example of multijurisdiction sharing and should lead to subsequent efforts in other areas.

Section U: Regional Cooperation in the Use of Computers

Chairman: Robert M. Fano, Professor of Engineering, Massachusetts Institute of Technology

Robert M. Fano

Our main objective here is clarification of issues, not policy recommendations. In order to facilitate this process, I wish to lay out a set of questions which will focus the discussion.

First, why should there be cooperation in the use of computers? To reduce operating costs? Because one community can't afford the money and other costs associated with the implementation of such a system? To promote cooperation in more substantive areas, especially operations?

Second, what are the problems involved? We cannot consider these immediate questions without asking some more fundamental questions:

-- Computers for what? To collect data and facilitate communication? To promote new kinds of thinking and analysis? These are quite different things.

-- Computers for whom? Top officials? Lower officials? City workers? The general public? Again, very different kinds of system designs are involved.

-- What are the costs and side effects of the use of computers in public policy processes? Less privacy? Higher costs? More inconvenience? Each of these results is a very frequent outcome of the shift to computers.

-- Batch processing and shared access have very different operating characteristics and should be used accordingly for different purposes. Higher cost should be balanced against the ability of a system to evolve, grow, and adapt to new situations.

John Kemeny, President of Dartmouth University

It seems to me that we use computers for three quite different but related kinds of work. First, we need management information and planning systems. This area is terribly crude, even in industry. There are only a handful of executives in the U. S. today who could begin to answer detailed questions about the affairs of their own companies, e.g., the composition of their work force according to various characteristics and the implications of this composition in dollars for their compensation, incentive, and pension systems in years to come. Second, we need time-shared computing capacity to cope with the vast amounts of data generated by modern research and the sophisticated mathematical methodology available for analyzing this data. Time-sharing and computers have wrought a low-cost revolution in research in most fields. Third, we need simulation models as a management and planning tool. For this more than for the other two basic applications, we must be able to interact with the computer to change the model on the basis of past results.

What we are really talking about in each of these three basic applications is the evolution of man-machine combinations or teams for joint research, joint management, joint planning. And the main problem in this evolution is, I feel, the rapid creation of effective software. Hardware, though obviously troublesome and limited in many respects, is developing rapidly. New systems are orders of magnitude better and cheaper than their predecessors. On the other hand, software for interactive systems is difficult to produce and will be a bottleneck in the application of time-sharing to a wider range of uses. Staffing is a terrible problem; there is an absolute shortage of competent, experienced people, and this will continue indefinitely. As a result, we can do twelve major time-sharing systems at a time (e.g., Dartmouth, MDS), but certainly not 500.

As a way out of this dilemma I propose that an independent agency be established (or the existing analogous functions of the National Bureau of Standards be expanded) to undertake large-scale, systematic experiments in the development of interactive systems. We simply cannot continue on our present ad hoc basis of everyone developing his own independent time-sharing as Isaacs has done. The success of systems like MDS, while gratifying and instructive, by itself does nothing to insure that similar systems will find their way into the average city, or even into our principal cities. Pilot programs are almost always easier to bring about than extended implementation, so we must concentrate our attention on the latter. I see no substantial technical problems which would prevent the development of truly flexible software. Small differences in the needs of different specific situations can, I believe, be ironed out. (Perhaps a set of instructions could be developed for adapting software to meet various contingencies, so that the actual work of adaptation could be done in the field without the help of the sophisticated systems programmers.)

It is also important to note that the users of time-sharing systems are themselves producing much useful programming. Every user of Dartmouth's system, for example, is making potentially useful software to fit his own needs; many innovations have been formally incorporated into the system itself. An independent agency could assist in the systematization and dissemination of new developments from the field.

There is no real substitute for well-designed shared access systems in research and government today. Unfortunately our main competence in the design of such systems today lies in a few private firms and a handful of universities. This situation must change.

Mr. Freeman, Raytheon Service Company

Developing shared-access data processing systems demands research efforts which are unlikely to produce short-run profits for industry. Industry could bring its considerable skills to bear on these problems, however, if the government were willing to commit long-range venture capital in order to guarantee a reasonable return to business.

Herbert Isaacs

Unfortunately a major contribution by industry tends to tie the resulting software to the equipment of a single manufacturer, which is clearly unacceptable politically. There must be open competition for hardware bids, and for this reason alone there must be some separation of software development from production and sales of hardware. Here government must make more than a financial commitment. The situation is analogous to housing, where decades of purely financial incentives have failed to elicit more than a modest pilot effort. Where there are many separate jurisdictions with superficially different requirements, the government must take action to either modify the requirements or to develop technology applicable to a wide variety of situations. The latter approach is now being used in HUD's Operation Breakthrough, and it will probably have to be used in the present software impasse as well. After that, we can expect that industry will do a very efficient job of marketing and disseminating the new technology. The Urban Information Systems Interagency Committee is currently funding research to develop software prototypes which can be transferred. Can we really develop software that can meet the operational needs of a large number of cities?

In theory it is possible to develop a system in North Carolina which will be applicable in California. In fact, it is very necessary that we pay attention to different specific requirements in different localities. There are two ways around this dilemma. First, and most obvious, perhaps, is the need for compromise. This can be achieved through real joint development work, say, between North Carolina and California. We simply cannot possibly develop a system in North Carolina, then spring it on some unsuspecting California community.

Second, we need an active technical advisory service which would produce special application packages to help California adapt North Carolina's system which had already been developed with some view to California's needs, to California's idiosyncracies.

Dr. Kemeny

It seems to me that there are two main barriers to the spread of management information systems (MIS) in city government in the U. S. First, there are psychological problems. Before you invest in MIS, you must specify in considerable detail what it is you want your system to do for you. This is an intellectual task of considerable magnitude which few city governments are able or willing to undertake. It demands thorough understanding of the way in which a government apparatus really works, especially where decisions usually get made. It also demands an able and stable management group with whom the contractor can interact while the system is under development. A second and perhaps more subtle problem is the development of reasonable techniques of accounting and accountability for use with information and data processing systems. Few people, especially at the Bureau of the Budget, seem to understand that it is often very efficient in terms of overall effectiveness (e.g., frequency of use, or cost per access) to run shared-access EDP systems very inefficiently (in terms of users per unit time) merely in order to make them easy to use, and therefore to encourage a wider range of users and a greater volume of use. Don't worry about "efficiency"; look instead at the users. Are they having difficulty? If so, no matter how efficient your system is, you're not getting what you should from it.

Mr. Isaacs

While we're talking about MIS, we'd better note that we can never expect people to buy just management information systems. MIS, at least at its present stage of development, is an extra and perhaps desirable payoff that comes after the bread-and-butter applications, e.g., utility billing and tax accounting, have been realized. Data processing systems have to be sold on this basis. Not many people really understand MIS.

Mr. Fano

Another thing that bothers me about MIS is this: who will put the data into an MIS system? The answer is, of course, the same people as take information out. This means that the users of a management information system must be thoroughly committed to it, feeling that the system benefits them directly and knowing that their own operations will be hurt unless they put accurate and timely and complete data in. This is work, but unless this is done from the very beginning, the system will never be of any use to anyone. We must therefore somehow demonstrate the real immediate payoffs of MIS to the potential users of a system before it ever goes into operation.

Q.: What about the issue of privacy in relation to information systems, especially the security of sensitive data files?

A.: Mr. Issacs: The structure of data files, specifically their inter-accessibility and technology which determines access to particular data files, ought clearly to be a matter of specific public policy.

Mr. Fano

We must develop methods of implementing public decisions about privacy; otherwise many important applications will simply never happen. There is no real basis on which to handle many of the legal dilemmas which may arise out of information-system technology; this body of case law and a set of guidelines for legislation must also be developed, and soon. The basic problem here is the joint interest of the public and private individuals in information. Data which are originally gathered for routine public statistical purposes may prove to be highly damaging to an individual if allowed to stray or in case of clerical error. The effects of the lack of mechanisms for dealing with this conflict are already being felt. In hospital information systems, for example, the trend is toward omitting certain very relevant kinds of information (e.g., a past history of alcoholism) completely from a patient's file if there is a possibility of violation of joint interest (e.g., unauthorized or unanticipated access to files). There is also a need for giving people the possibility of challenging information on file about themselves. This would involve letting individuals know that information is on file, divulging that information, and giving them a chance to correct it if it proves to be in error. The magnitude of this task becomes apparent if we consider the work involved in notifying the subscribers to telephone service in a particular city of the comparatively trivial information contained in telephone company data files.

This raises the further question of information for whom? Existing management information systems seem to concentrate their attention on two categories of roles within government: (1) planning and management; and (2) operational positions making heavy use of rather uniform categories of information. There is a third category, however, which has been neglected until now: the public. Information is the basis of responsible participation in public affairs, especially the adversary types of actions which have been seen in recent years. Any information can obviously be helpful to individual citizens in their everyday pursuits as well: for example, lawyers and assessors could greatly benefit from remote access to automated land-use files. Information on available types of recreation at given times and levels of use could help families make more productive use of our existing recreation facilities. Often the costs involved in making files accessible to the public are minimal when compared with the costs involved in compiling the information in the files originally. Thus the benefits from large spent investments can be significantly augmented in many cases by limited additional expenditures for the dissemination of information. And there is one other argument for public access to information systems which should be kept in mind: we can hardly expect to be able to persuade the public to support large expenditures for information and data-processing systems if the public has had no contact or experience with such systems in its everyday life.

Mr. Isaacs

There is more to be said on the demonstration of benefits from information and data processing systems. Shared-access systems are clearly desirable for city government, but so are many other things. In reality direct arguments of efficiency and decreased operating costs are not very strong. But there are second-order effects of systems (such as MDS) shared among a number of towns, which I believe argues for according them a very high place in our set of priorities. Cooperation on computation facilitates cooperation in substantive areas of government. The ease of transmission of data encourages moves toward regional planning and more responsible decision-making by individual cities. The reverse of this also holds true: the urge toward individual empire-building is always strong in smaller cities, and sharing one's information is felt by many to reduce one's place in society. Cities can become very possessive about their data because losing control over them may be a prelude to more substantive losses in inter-city maneuvering. (And thus the inter-city discussions on the board often reflect larger inter-city concerns and conflicts.) But we should give some thought to how much of a premium we might be willing to pay for increased cooperation among city governments. Even 20 percent might not be unreasonable. Computers so facilitate the transfer of information that at least mutually beneficial cooperation among cities is made much more likely.

Section V: Citizen Feedback Systems

"Citizen Feedback Systems"--Chandler Harrison Stevens, Senior Lecturer, Sloan School of Management, Massachusetts Institute of Technology

Citizen feedback, in response to government policies and programs, comes in various forms, many of which we take for granted. Voting, applause, individual expression, and political organization are direct forms of citizen feedback. There are also a number of indirect forms of citizen feedback which are derived simply from what individuals do from day to day. The actions they take, the decisions they make, what they choose to learn, and how they innovate in their daily lives--these activities are all subject to certain government influences, constraints, and incentives. Such activities often "say" something about public policies and programs, about how well they are working, about whether they are achieving their objectives, about what unexpected secondary effects may be occurring, etc. If such activities are "read" properly, they can provide valuable feedback information to government. However, in a broad sense, indirect citizen feedback includes a myriad of statistics, of social indicators. Such information as this is better referred to as "social feedback" rather than "citizen feedback" since the citizen is less consciously in direct control of this information.

But in order to understand the purpose of more conscious and more direct citizen feedback, first consider one particular set of statistics which individuals generally feel is beyond their direct control--that is, prices. If a market is competitive, no single buyer or seller can noticeably affect the market price. Each decision to buy or sell is in a sense a vote for a particular product at a particular price. If enough such votes are not forthcoming to clear the market, then the price should change.

The price mechanism when it is working well would thus seem to be a more efficient communicator than the ballot box since voting occurs infrequently, every year or two or four for many elective offices, while buying and selling goes on continuously. However, the price mechanism does not always work. For example, there are certain public goods such as national defense which individuals cannot purchase individually. Also, there are certain effects of economic activity which tend to escape pricing--such as environmental pollution. Furthermore, the price mechanism could never be considered a substitute for voting since inequities in income distribution severely limit the power of a large segment of the buying public. Finally, an inadequate flow of information to all consumers limits competition and encourages monopoly pricing and a poor quality of goods.

Such shortcomings do not mean we should abandon the price mechanism in areas where it does not work well. In fact we are only beginning to realize that some of our most severe public problems can best be dealt with by constructing incentive structures which use the self-adjusting mechanism of prices.

Science and technology have helped set the stage for such proposals. Television has created a new form of literacy which tends to reach even the most disadvantaged and impoverished segments of our society. The poor today have better information with which to make their own decisions; the paternalistic welfare system of yesterday is obsolete today. In the not-too-distant future, still better information on product quality and price comparisons should become available to all shoppers, perhaps through computer terminals in shopping centers or through shopping services over the telephone or over cable television. Computer terminals, new telephone devices, and cable television should permit retrieval of information which is more tailored to individual needs than is the information found in the media today.

Science and technology not only should help improve the price mechanism in certain areas but also should help introduce something approximating the price mechanism in other areas where it does not now exist. Although science and technology are blamed for much of our present pollution problem, science and technology have also yielded measuring and monitoring techniques which can determine the source, quantity, and quality of certain pollutants. Without this capability we previously have allowed our rivers and our atmosphere to be used as free, open sewers. New information technology allows us to render new accountings which can be the basis for social cost/benefit analysis and then for new social incentive structures.

At this particular time science and technology can be more fruitfully applied to improving the quality and quantity of citizen feedback than to practically any other public program. In delineating what we mean by citizen feedback, we might let prices and votes serve as rather concrete boundaries between which citizen feedback falls. Citizen feedback is information initiated by the citizen and directed to social institutions in order to improve the quality of life, the quality of the environment, the policies, programs, products, and services of those institutions. In the public sphere voting is a major feedback mechanism; in the private sphere, pricing is. Here we are concerned not so much with voting and pricing as with information mechanisms which supplement these two, first in the public sphere, but also in the private sphere, particularly since those two spheres are tending to overlap more and more as government becomes more concerned with consumer protection, with labor-management relations, and with civil rights, and as private enterprise becomes contracted by government to work on social problems and becomes influenced by government incentives which reflect the social benefits and the social costs of various forms of private activity.

So while we will be concerned with the private sphere as well as with the public sphere, we will start at the public end of the vote/price spectrum.

It is becoming increasingly obvious that voting for elected officials at infrequent intervals does not fully satisfy the desires of many citizens to participate. The communications revolution has made electoral democracy of this sort obsolete. While voting for elected representatives is still necessary, it no longer seems to be sufficient.

Television has made the citizen considerably more aware. He sees in his own living room war being fought, often in television's "living" color. He may vote for a presidential candidate who promises not to escalate a war (as many thought they did in 1964), but then later see that promise go unfulfilled.

In many political contests he may see little difference between competing candidates as he agrees and disagrees with each on different issues. The electronic media have made the citizen aware of conditions well beyond his own neighborhood, and thus have given him a better perspective to tackle problems close to home, if he only had the power to do so. He generally doesn't see that power in the act of voting at infrequent intervals for remote officials who cannot observe problems in his neighborhood.

Instant news has short-circuited certain communication hierarchies of the past--particularly government bureaucracies and political parties. Even the chief executive of a state or nation seems to learn more about what is going on in his own government by reading his morning newspaper than by receiving communications through "normal channels." Yet while there has been considerable speedup of communication from the center out to the citizen, little has yet been done to increase the speed of communications back in to the center from the citizen, who is still expected to "go through channels" with his inquiries, requests, complaints, suggestions, opinions, etc.

TWO ROLES FOR SCIENCE AND TECHNOLOGY

1. System development--emphasis on technology
2. System operation--emphasis on science

In the broadest sense, the "technology" of the overall citizen feedback system includes the hardware, the software, the organizational structure, the skills of people operating the system--in other words, the total system with all of its components, its assumptions, its constraints, and its scope. This system, as well as the broader social system of which it is a part, incorporates in relatively fixed form many decisions made by the society in the past. "Science," again in the broadest sense, can be applied to that remaining area of societal management, left relatively free by "technology."

This division of roles is by no means precise, since it is, of course, science which is applied over the long run to modify technology. What modifications take place in the technology of the society--i.e., its citizen feedback system, its transportation system, its economic system, its environmental control system, its educational system, etc.--should be determined not only by science, but also by citizen feedback.

Our principal objective here is to suggest that society must listen better both to science and to its citizens. To control technology, to formulate public policy, to improve public programs, and to evaluate public service, we need not just citizen feedback, but "informed" citizen feedback. It should be the job of science to help provide quality feedforward, to state alternatives open to society, to sift out the technical cause and effect complexities so that what is left for presentation to the citizen is a set of understandable alternatives about which value judgements can be made.

The scientist must help state alternatives without imposing his own value judgements. This can never be done perfectly, but a citizen feedback system can have its own self-correcting devices for minimizing bias.

For example, consider one possible form for what might be called an "issue ballot." Suppose in your Sunday newspaper there were a single pullout sheet which you could mark with a pen or pencil indicating how you felt on certain issues. You could then drop this "ballot" in the mailbox. Your ballot along with others could be read by optical scanning equipment and tabulated by computer. An analysis of the results could then be published to provide public information about how a significant number of concerned people feel on certain current issues.

How biased these judgements might be could be checked by standard opinion polling techniques. Whoever would draw up the ballot questions in the first place would most likely add some of his own biases no matter how hard he tried not to. Furthermore, newspaper columns written about the issues under consideration could appear in the same Sunday newspaper, perhaps purposely coordinated with the appearance of the issue ballot. Even though opposing viewpoints could be presented, the quality of the arguments could still create bias. There could also be bias as well as educational information in related television shows (again perhaps purposely coordinated) programmed to appear on Sunday, Saturday, Monday, or at least sometime close to the time of "issue balloting."

How could the element of bias or propagandizing in accompanying education communications be corrected? Why not again through citizen feedback? The next to last question on each issue ballot could ask respondents to rate the "fairness" of the questions and of the various statements of the issues in the media. The last question on each issue ballot could ask the respondent to choose from a list of possible issues to be considered on the next edition of the issue ballot, since otherwise there could be considerable bias in the choice of issues.

The need for public education in a good citizen feedback system should not be underemphasized, but the need to guard against propagandizing cannot be overemphasized. Propagandizing by a "knowledge elite" is no more desirable than propagandizing by political dictatorships or by Madison Avenue advertisers. Science has an extremely important role to play, but that role does not include the making of ultimate value judgements which in a democracy should be left to the people. While the democratic ideal can never be fully achieved, the communications revolution demands that we move decidedly in that direction.

Another example might help to illustrate how a system might attempt to minimize bias on the part of the system operators, the fact-finders, the scientists. Suppose computer terminals were installed in shopping centers, in order to provide consumers with better product information. This might include information on services in the public sector as well as in the private sector.

Again the question of "Who watches the watchman?" arises. Suppose the information available in the computer information retrieval system has been compiled by Consumers Union. Bias can arise in the choice of what particular types of information are made available to consumers through this system. But again citizen feedback can help counter such bias in that the system could be guided by the questions asked by the users of the system. If the consumer wants more information about tire safety than about tire durability he should ask for it. Certain questions may go unanswered by the system if they haven't arisen previously; other questions which are asked with increasing frequency might be researched in greater depth by Consumers Union in order to suggest to the user what additional related questions about quality might be important to him. If the computer terminal provides the consumer with an information source with which he can interact, then the source and the user can both learn from each other.

Many persons may initially shy away from computer systems as too mysterious or too complicated to deal with. Nevertheless, as the design of the man-machine interfacing improves, many more people can be expected to use such information resources. This new kind of "individualized media" should become less time-consuming than today's fact-filled "mass media." There will be no need to wade through a lot of irrelevant information to get at particular facts of interest and of value to a particular individual.

The technological problems which we face in building better citizen feedback systems are many and varied. But most could be solved, easily within the present decade of the seventies, if a strong enough commitment is made now. An example of a problem requiring new hardware is the problem of man-machine interfacing. Already new telephone equipment--the touch-tone phone and the automatic card-dialer--can be used to directly key numbers or data into computers. Certainly the familiar household telephone, in whatever new form it takes (displaying pictures, triggering computer generated voice messages) will seem less complicated and will be less expensive than computer terminals are today. Eventually cable television might offer a substantial advance in man-machine interfacing and might represent a new medium which would allow a great deal of individual selection of information and citizen feedback response right in the home. But, in the more immediate future, a three-way tie between television, the time-shared computer, and the home telephone holds the greatest promise for individualized feedforward and citizen feedback.

The feedforward process through television will require a better application of art as well as science. Many great playwriters have built their reputations on presenting public issues in the form of entertainment. On the television program which most incorporates citizen feedback today, "The Advocates," both sides of an issue are presented but in a style more appropriate to the courtroom than to television.

The development and operation of a good citizen feedback system is a challenge of considerable scope--a challenge which can only be met by a blend of art, science, new hardware, new software (e.g., computer programming), new techniques, new skills, etc. In a recent speech before the Operations Research Society of America, I also suggested that such a system requires much in the way of new decision models and new organization structures.

The ultimate objective of such a system is also one of considerable scope. In Puerto Rico, Governor Luis Ferré has had us developing a system for handling both "service feedback," which includes inquiries, requests, and complaints, and "involvement feedback," which includes opinions, suggestions, and volunteering. We do not expect that we can encourage much in the way of involvement feedback, which qualifies more as "citizen feedback" than does service feedback, until first we handle service feedback in a way which regains the confidence of people in their government. Why talk if you think no one is listening?

The ultimate objective of a citizen feedback system is citizen participation in social decision-making. However, the word "participation" has been overworked in recent years. Ad hoc participation schemes have not always been successful and have often seemed to widen the credibility gap and to increase rather than decrease citizen alienation. True citizen participation can only be constructed upon the type of firm foundation which an effective citizen feedback system would offer. Citizen alienation can only be abetted through a societal information system which reaches out to the alienated, for they, by definition, are now cut off from "The System."

It has taken us much too long to acknowledge the seriousness of environmental pollution, but citizen alienation may be an even more serious problem in a democracy, since we depend on the citizenry to actively support whatever actions are needed to combat other serious problems like environmental pollution. Our most valuable resource is not the air we breath or the water we drink but the thoughts we think. Citizen alienation is in fact our most serious form of pollution.

The principal source of this type of pollution is bureaucratic paternalism which spills out of big government, big business, big unions , and other big organizations. These bureaucracies cause petty frustrations and stifle creativity among both their members and their constituencies, thus threatening not only our mental health, but our economy, our democratic system, and our total environment. There is a cure however, and it falls well within the bounds of "peaceful revolution." The best way to fight The System is with a better system--a citizen feedback system.

Section V: Citizen Feedback Systems

Recommendations

1. Citizen feedback systems should be designed that serve both to

    a. help set goals of public programs;

    b. monitor the effectiveness of public programs.

2. The measures employed in a feedback system should measure both the intensity of feeding on current feedback and the responsiveness of institutions to past feedback.

3. Information received by such a system should be stratified in order to permit an evaluation of the legitimacy of the sources for the feedback.

4. Data on the present feedback systems used by highly-buffered public authorities, political organizations, and media innovations should be collected and analyzed before new feedback systems are institutionalized.

5. Pilot experiments in citizen feedback systems, e.g., neighborhood city halls, should precede major projects.

Section W: Development of the Shore and Continental Shelf of the Northeast Region

"Shore Development in New England"--K. O. Emery, Woods Hole Oceanographic Institution

Geological Factors

Any kind of projection into the future benefits from a review of the past, and shore development is no exception. For New England the most important natural event during the past was glaciation of the region. Although the last glaciers were gone about 12,000 years ago, their effects linger on, with different results in northeastern New England (Maine, New Hampshire, and Vermont) from those in southwestern New England (Massachusetts, Rhode Island, and Connecticut). When the weight of ice was removed, the coast rebounded as much as 730 feet in the north but essentially not at all at the southwest. Simultaneously, sea level rose about 430 feet, as meltwater returned to the ocean. The net effect is that the northeastern coast is an emergent one, and the southwestern coast is a submergent one. The relative movements can be expected to continue for several thousand years. A perhaps more direct effect of glaciation was its control over the composition of the shore zone. The shore at the northwest is mainly rocky; gravel or sand beaches and mud shores occur only in short embayments that are protected by rocky headlands. In contrast, the southwestern coast consists mainly of long sand beaches, most of which are backed by broad marshes. The trend continues to beyond New England, so that the shores of New York and New Jersey are virtually 100 percent sand beaches, nearly all backed by marshes.

Throughout all geological time, the shores of the ocean have been sites of change, whereby the land builds seaward by deposition, or the ocean is victor over the land by erosion. These changes will continue in spite of temporary (and expensive) attempts to prevent them. The natural changes will be minor in the northeast, because the shores are dominantly rocky; they will be at a minimum for sea cliffs rising from deep water, and at a maximum where sediments from land build deltas in river mouths (harbor siltation). Changes are bound to be great in the southwest, because the shores are low with gentle slopes rising from shallow depths; their dominant composition of loose sand allows them to easily be altered by waves and currents. Changes occur in both annual cycles and long-term progressive alteration. The annual cycles are exemplified by the wintertime narrowing of beaches by large storm waves and the summertime broadening of beaches by small waves. The longer-term changes are largely due to the slow rise of sea level, which averages nearly a foot per hundred years (a large rise, considering the gentle slope of beaches and marshes), that is opposed by the deposition of new sediments provided by erosion of the land and sea floor.

Human Factors

Homes. Cities historically have been built at river mouths in order to simplify the import and export of cargoes. Land transportation between the cities follows coastal plans as much as possible in order to take advantage of direct routes and easy road building. As a result, the more affluent inhabitants of the cities have had access to coastal areas outside the cities for commuting and retirement. Esthetic advantages include open spaces, broad marine vistas, and clean beaches. Need for services immediately led to the establishment of villages with small industries. In recent years, the trend toward coastal suburbia has been accentuated by the social, economic, and architectural ugliness of the cities and by the fact that much light industry (including electronics, book publishing, education, and general research) can be more easily and cheaply conducted in suburbia than in the city. As a result, the "development" of the coastal zone has proceeded with ever increasing speed. The relationship is illustrated in Table 1. This takes the form of increasing population density per square mile, and increasing income (both per capita and per region). It also can be expressed in terms of a southwesterly increase in number of people per mile of coast and increase in regional income per mile of coast. Because of the large number of people in New York State (and especially in New York City), the population pressure on coasts, particularly of southwestern New England, is increased above the pressure from the region's own inhabitants.

The population and financial pressure on the coastal zone take many forms. One is the steadily increasing cost of coastal home sites; the rate of increase may even exceed the rate of increase in costs of the best metropolitan property. One result is that many homes have been built and still shall be built on marginal and unsafe

TABLE 1

THE COAST AND ITS INTERACTION WITH POPULATIONS

	Coastal Dimensions				Regional Data					
STATES	Total length (mi.)	Rocky (mi.)	Sand or Mud (mi.)	Backed by Marshes	Area (sq. mi.)	Population 10^6 (1960)	Income $\$10^9$ (1960)	People per sq. mi.	People per mi. of coast	$\$10^6$ per mi. of coast
Maine New Hampshire Vermont	3609	2600	1009	650	49,302	2.0	4.7	40	553	1.3
Massachusetts Rhode Island Connecticut	2521	934	1587	960	13,826	8.5	26.6	615	3370	10.5
New York	1850	0	1850	1550	47,939	16.8	55.0	350	9090	29.7

property, particularly on beaches. The developers and home owners evidently disregard or are unaware of the fact that the beach belongs to the ocean, which is fully capable of demolishing homes that man thoughtlessly builds there. Government aid to those whose beach homes are destroyed is a farce, when it is expressed in terms of aid for Acts of God. Obviously, expensive engineering works (breakwaters, groins, jetties, etc.) can be built, but their construction largely eliminates the esthetic values for which the shore was chosen as home sites in the first place. Moreover, many or most engineering structures designed to retain beaches (groins, jetties) serve to accentuate the loss of beaches farther down coast.

In order to avoid danger within the shore zone, many homes have been built upon view sites at the top of sea cliffs. The very existence of a steep and vegetation-poor cliff means that the cliff is being undermined at its base by wave action and is retreating by landsliding. In reality, the homeowner should not be surprised to find his home undercut and destroyed, particularly during winter storms and especially where the beach has been lost. Waste waters from irrigation, septic tanks, and housetop or street drainage commonly are concentrated below the houses, serving to increase the rate of cliff erosion and retreat.

Other Constructions. Another aspect of natural change which man tries to prevent (but actually may often accentuate) is the silting of harbors, river mouths, lagoons, and marshes. In seaport and other city areas the intentional filling of these areas progresses at a very great rate. Even in suburbia, it is common enough to cause concern to those who wish to preserve natural environments and their fish and bird populations. Past farm practices and present industrial effects cause rapid silting of shallow coastal indentations at the same time that natural siltation is to be expected. These are the same areas in which local populations demand marinas and sportfishing facilities. Obviously, two broad interests are competing: one group casually or unknowingly using the shore zone as a dump, and the other trying to shape it into a desirable but not a natural environment. The latter is not only expensive, but doubly so when opposed by the former.

Clearly, the problems raised above are most acute for southwestern New England. They are relatively unimportant in northeastern New England owing to both a lesser population density and a more stable and rocky shore zone.

Offshore Industry

Newspapers carry many stories about the need to prevent the establishment of an offshore oil industry within areas under state jurisdiction. This fear is completely unfounded, because the ocean floor within the three-mile limit of state control off New England is unfavorable for oil production. Along the entire length of New England, the bottom consists of glacial and post-glacial sediments less than about 1500 feet thick and resting upon granite or other equally oil-barren rocks. There is extreme doubt that any oil production whatsoever can be attained within the three-mile zone; likewise, there is no opportunity for the states to gain oil bonuses or royalties. On the other hand, oil production farther offshore on the part of the continental shelf controlled by the federal government is considered highly likely. Moreover, continued occasional pollution of the shores of New England is certain to occur both from federal wells and from tanker cargoes brought from other parts of the world.

A second offshore resource which is likely to be developed in the future is sand and gravel for use in land fill and other construction purposes. Such material is minor in quantity off northeastern New England, but is very abundant off southwestern New England, particularly outside the Gulf of Maine. Much care should be taken for the issuance of permits for sand and gravel dredging in the areas where the material is in moderate supply but demand is large (near Boston and in Long Island Sound). If dredging is conducted near the shore (and the distance is subject to geological factors, not legal simplifications), it easily can cause severe depletion of beaches. Large quantities of sand and gravel occur in areas where they are not wanted and where fishing activities will not be greatly affected, such as Nantucket Shoals and parts of Nantucket and Vineyard sounds. Clearly, the contractors will so vigorously demand access to supplies near the areas where the sand and gravel is to be used, that they are likely to be issued permits in spite of resulting long-term effects.

In some other parts of the world, tin, titanium, zircon, and diamonds are mined in offshore areas. Coal and iron have also been mined from drifts extended under the ocean. Elsewhere, preliminary investigations have been made for possible mining of offshore gold, phosphorite, and manganese nodules. There is absolutely no likelihood of any of these materials being present in commercial quantities off New England, within either state or federal jurisdiction.

Conclusions

The shore zone is an area in which large natural forces are active. Man can oppose these forces, but at great cost, and with the probability that the product of his efforts will be much different from the characteristics of the environment that attracted him in the first place. Moreover, one must question the justification whereby this generation has the right to alter the limited shore zone with no regard to the interests of future generations. These points indicate that much care should be taken to avoid the imposition of extensive engineering works upon the shore zone, especially because many such works produce unexpected and undesirable results.

The problem of preservation of shores for the future is certainly one that is large enough to be worthy of cooperation between the public, industry, and government. The public can help even by such small acts as reduction of litter; for example, I am always pleasantly surprised by the frequent use of litter cans on streets, and expect that the same use can be accomplished on beaches. We perhaps can enlist the present crusading interest of youthful protestors against pollution. Industry has a very large role to play in selecting pilots and ship-masters for oil-barge tugs as well as million-barrel tankers. Licensing agencies can be more demanding, and government may be able to enforce the bonding of oil shippers, with bonds to be renewed as they become used for clean-up operations. Similarly, the offshore mining of sand and gravel for the largest land-fill operations (airfields, public housing developments, etc.) can be restricted to safe areas by law and by subsidy.

Many of the adverse effects of population pressure upon the seashore could be relieved by the presence in state or even in large city governments of qualified geologists. New England has notably poor state geological surveys, and at least Massachusetts has no state geologist whatsoever, being content to rely upon aid from federal geologists. The states also are in debt to the federal government for having the foresight that the states lack to preserve shore areas such as the Cape Cod National Seashore. Might not the states relieve the pressure upon beaches near seashore towns by providing access to intervening beaches that are virtually deserted? An example of the toughness that town governments can provide is given by the great difficulty offered land developers who wish to fill marshes in and near the towns. In this way the marshes are preserved for their ecological and esthetic values, and the unwary buyer is aided in avoiding a home subject to flooding.

Section Y: Technology Transfer

"Toward a Federal Technology Transfer Program"--Peter E. Glaser, Arthur D. Little, Inc., Cambridge, Massachusetts

Introduction

Every society--with social progress and growth for the common good as principal objectives--prospers through innovation. Technology can bring a previously unattainable goal within reach, creating new opportunities for men and society. To exploit such opportunities may require alterations in social organizations which may result in stresses and dislocations of the type we are experiencing today.

Technology Transfer

The process involved in the transfer of technology has been discussed in many different forums and much has been written on the subject. Yet, little appears to be known about the interplay of political, social, economic, and social conditions in this regard; or the benefits resulting from the process; the evaluation of alternative approaches; and the adoption of policies required for optimum transfer of the technology.

Historically, technology was transferred almost routinely between various business enterprises. In the past, considerable penalties were enacted upon individuals who possessed special skills and knowledge which, if shared with others, would have diminished the favored positions of rulers or nations in that particular field of technology. Today we hold the opposite view and efforts to close "technology gaps" and improve "the technological balance of payments" are fundamental in our relations with the nations of the world.

The diffusion of technological innovations resulted in a near doubling of the output per man-hour in this country. It is well understood that innovative business enterprises enjoy the most rapid growth patterns, that their products find the widest acceptance in the marketplace, and that their shares are most highly valued. It is significant that the major innovations in this century have come from independent inventors or small firms, although larger firms utilized innovations faster than the smaller firms.

Technology transfer connotes to some a modern-day version of distributing manna from heaven to the grateful multitude, rather than recognizing the considerable challenges faced when the barriers to the transfer of technology have to be overcome. These barriers are not just technical in nature; factors such as financial risks, politics, fear of change, legal restrictions, marketing problems, lack of an institutional framework, and sheer inertia represent some of the constraints. Passive programs to study and plan technology transfer by themselves are not well suited to either the problem-solving or the promotion activities required for the transfer process. In spite of considerable efforts devoted to planning programs, technology transfer rarely occurs along logical lines which can be definitely planned in advance.

The Role of the Government

It is fundamental that the assistance the government provides must be available to all of industry. However, when viewing the distribution of federal funds, one could argue that a justifiable bias to assist those firms not receiving their proportional share of federal support for R & D should exist. The "survival of the fittest" is a platitude often quoted when support for smaller business firms is discussed. However, it may be in the national interest to support certain industries for reasons such as potential unemployment in case of failure, regional development, or to maintain a resource.

Today the government bears prime responsibility to assist industry when it imposes new regulations and controls which could affect industry adversely, particularly those regulations designed to maintain and improve the quality of life and the environment.

There are a number of federal agencies which have responsibilities in the area of technology transfer. Their roles range from a passive, nonselective library function to a problem-solving, entrepreneurial approach.

The National Science Foundation, which is indirectly involved in technology transfer through its concern with improving scientific information systems, performs research on the communication of scientific information. The Department of Defense, through the Defense Documentation Center, provides technical information services for DOD contractors, for DOD itself, and for other qualified users. Health, Education, and Welfare, in conjunction with the National Library of Medicine, has set up a computerized information file and retrieval system for biomedical information to provide bibliographic access to biomedical literature through several field centers. The Smithsonian Institution operates the Science

Information Exchange to provide referral service on R & D contracts funded by federal agencies.

The Small Business Administration provides a limited information service to small business, primarily through distribution of NASA-prepared literature. The Library of Congress, through its Legislative Reference Service, has provided material on policy planning for technology transfer. The Department of Commerce, through its State Technical Services program (recently discontinued) and the Office of Field Services, is engaging in problem-solving activities, educational programs, referral, and information services.

The Department of Commerce is also responsible for the Clearinghouse for Federal, Scientific, and Technical Information, which provides a library service for unclassified and publicly available documents from federal R & D projects, including a limited literature search and referral service. Through the Patent Office, the Department of Commerce has established the transfer of technical information as applied to new inventions which may have commercial value. Government patent policy promotes the use and practice of inventions resulting from federal contracts.

This brief summary shows that there has been widespread recognition that information accumulation and dissemination are valid and valuable federal activities. In addition, a vast system for exchange of scientific and technical information has been built up both here and abroad. The problems in obtaining this information are not caused by a lack of mechanisms and channels for information exchange; rather, the magnitude of the task is difficult even for sophisticated information users working in highly specialized fields.

A Federal Technology Transfer Program

The technological needs of the smaller business firms were at least partially met by the State Technical Services (STS) program which, in its concentration on problem-solving activities through field services, was beginning to evolve a viable process of benefit to industry after only four years of operation. Our evaluation of the STS program* showed that it provided a useful and economic service in transferring technology which benefited the nation. We recognized that the program could have been more effective and costs reduced by concentrating the federal and state investments in efforts and services which would yield the most returns. We recommended that the STS program receive continued federal and state support with increasing emphasis on direct service to industries. However, funds were not appropriated for continued operation.

We concluded that the STS program should receive federal support because: (1) A major contribution of the program to economic development is the distribution of the costs of high-risk innovation across a large number of companies; (2) Increased tax returns are obtained from successful innovations which the program helped develop; (3) Social benefits are an important product; and (4) A major block to innovation by small firms with limited technical resources is the high risk associated with the cost of technical assistance in solving problems.

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*Program Evaluation of the Office of State Technical Services, report to Department of Commerce, Office of Program Planning, Arthur D. Little, Inc., October 1969.

The STS program can be considered a precursor of the integrated, federally sponsored technology transfer program which would draw upon the information compiled through the activities of other agencies. The prime focus of the STS program was assistance to small industry. Even in the limited time of its operation, it had a number of successes which benefited industry and the states in which the specific businesses assisted by the STS program were located.

Examples of program activities included computer support designed for the construction industries in Illinois, composition of bricks for a manufacturer in Georgia, industrial engineering for a steel mill in South Carolina, and literature search service for an electronics manufacturer in Wisconsin. Even if we do not accept that the STS program was solely responsible for improvements achieved by an individual company in its operation (the business executive bears the greatest risk and provides the most valuable inputs on his own), the net economic effects in the nine sample states where we examined the potential benefits from the technology transfer activities substantially exceeded the program expenditures. The STS program (taking the results for nine states) had a positive net effect upon the nation as a whole in terms of gross national product.

There is agreement between the legislative and executive branches that various activities which have a negative impact on the environment or the well-being of the society as a whole have to be regulated and controlled. A recent bill--S1750--is designed to "amend the Small Business Act to authorize assistance to small business concerns in financing structural, operational, or other changes to meet standards required by Federal law or State law enacted in conformity therewith." Although such financial assistance may eventually be available to the smaller business firms, who will be on hand to help to interpret regulations and standards in modifying a process, or who will assist in the elimination of undesirable side effects on the environment, including air pollution and water pollution, and who will suggest suppliers of equipment? The responsibility should be placed on the government and support given for this type of assistance.

The most typical example of the need for this type of assistance is the case history of the Vermont cheese industry, in which federal and state water pollution legislation forced cheese manufacturers to discontinue dumping whey into Vermont rivers and streams as of January 1, 1969. When the STS program director in Vermont learned of the potential impact of the legislation--bankruptcy or closing for some cheese producers and curtailed operations for others--he obtained information from the University of Vermont on the feasibility of converting the liquid whey into a dried, edible product. The results of the study were favorable and with these findings he launched a four-point program of action to (1) attract into the state a major food processor who possessed the required technology to operate a whey drying plant; (2) organize the 18 cheese manufacturers into a cooperative group that agreed to supply whey; (3) initiate steps to seek $2 million in federal grants and loans to the project; and (4) provide the leadership, direction, and coordination for the project.

This project is now moving forward through an $800,000 contract from the Federal Water Pollution Control Agency.

A significant aspect of the STS program was that a small number of successful technology transfers to industry accounted for the largest economic effects, with services by field agents being the dominant STS activity. In the nine states we visited, we found that the instances of successful transfer were only a small percentage of the total number of companies to which some form of service was rendered. Although further improvements in the operation of a technology transfer program can be expected to increase the number of such successes, the general distribution pattern is likely to remain the same; this is indicative of the high risk of innovative activities.

The high risk of innovation is particularly difficult to bear for smaller business firms. Federal support of a program of technology transfer which spreads the risks across a large number of companies can obtain a favorable ratio of return on investment. No existing federal or private institution is currently providing problem-solving services to small business firms on a personal contact basis on a national scale. On the whole, private institutions have not found it profitable to seek out and, therefore, are not serving the needs of smaller business firms.

As the STS program users became more aware of external technical resources, their desire to employ the services of private consultants tended to increase. Thus, the federal government was in no way competing with private industry in this program but creating added opportunities.

The need for new technology, of course, is not confined to small or medium-sized firms, but extends to the industrial giants of our economy. The major differences is that these large firms are in a better position to incorporate technology into their operations and can balance the cost of unprofitable developments with a few successful ones. Even though such firms employ substantial numbers of people engaged in R & D, they also look outside their organization for technology. For example, ADL, Inc., has provided services to firms which are at the forefront of technology by focusing on specific areas of new technology, such as electro-optical systems, document storage and retrieval systems, etc. How much greater therefore is the need of smaller firms for technology when they do not share significantly in the R & D dollar from the federal government?

Program Improvements

Mechanisms and activities have already been established which, when improved, strengthened, and directed, can perform an important service of benefit to the nation. An office for a Federal Technology Transfer Program would play an important role in guiding and coordinating the program, particularly when the states wish to continue to play an important role. Greater central control could produce effective utilization of the federal data base, foster university-industrial cooperation, accentuate programs which would result in economic benefits, obviate duplication of program functions, and improve communications at every level of the program.

These recommendations, if implemented, will:

1. Encourage smaller business firms to look outward for new ideas and technical knowledge.

2. Foster innovative activities necessary for economic growth.

3. Enlarge the opportunities for private institutions to work with smaller business firms.

4. Assist industry in applying its talent and energy to the solution of the nation's economic, social, and environmental problems.

Appendix A

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Connecticut Research Commission

Mr. Avery Colt, Assistant Director
The New England Economic Research Foundation

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Department of Mechanical Engineering
University of New Hampshire

Dr. Donald Dowd
State Liaison Division
The New England Regional Commission

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Director of Special Programs
Public Services Division
University of Maine

Mr. David C. Emery
Coordinator of Special Projects
Norwich University

Dean Martin Essigman
Office of Research Administration
Northeastern University

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Science Advisory Commission
Mellon Institute

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New Jersey Division of State and Regional Planning

Mr. Robert Hansen
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Office of Science and Technology
Department of Commerce

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Executive Director
The New England Economic Research Foundation

Dr. M. Frank Hersman, Staff Associate
The National Science Foundation
Office of Planning and Policy Studies

Mr. Fred Hills
NASA Electronic Research Center
Technology Utilization Office

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Science, Technology and the Professions
New York State Department of Education

Dr. Earl W. Lindveit, Director
Office of City and Regional Administration Research
Department of Housing and Urban Development

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Professor and Chairman
Department of Electrical Engineering
University of New Hampshire

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The University of the State of New York
The State Education Department
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Massachusetts League of Cities and Towns

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and Development

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Pennsylvania Department of Commerce
Office of Science and Technology

Mr. Robert D. Vessels, Director
Division of Industrial Sciences
and Technologies
New York State Department of Commerce

Mr. Richard E. Weston
The New England Regional Commission

Mr. Sidney Willis
State Planning Director
New Jersey Department of Community
Affairs
Division of State and Regional
Planning

Dr. Robert C. Wood, Director
M.I.T.-Harvard Joint Center for
Urban Studies

Mr. Richard Wright
Executive Director
The New England Regional Commission

Appendix B

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Office of the President
The Ford Foundation

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Vice-Chancellor
State University of New York

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President Emeritus
Rockefeller University

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Administrative Associate in the Division of Engineering & Applied Physics
Assistant to Dean of Faculty on Public Health
Harvard University

Dr. Milton U. Clauser, Director
Lincoln Laboratories
Massachusetts Institute of Technology

Dr. Pat Conley, Vice-President
Boston Consulting Group

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Lecturer in Economics
Northeastern University

Dr. Olaf Helmar, Senior Fellow
Institute for the Future
Middletown, Connecticut

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Boston College

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The New York State Pure Waters Authority

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Head of the Civil Engineering Department
Massachusetts Institute of Technology

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Yale University

Dr. Herman Rochwarg
Associate Professor of Management
Northeastern University

Dr. Jack M. Sable, Director
State Office for Community Affairs
Office of Economic Opportunity
New York City

Dr. Jeurgen Schmandt
Associate Director
Harvard University Program on Technology and Society

Dr. Donald A. Schon
Organization for Social & Technical Innovation, Inc. (OSTI)
Cambridge, Massachusetts

Professor William Seifert
Professor of Electrical Engineering
Massachusetts Institute of Technology

Dr. Peter L. Szanton, President
New York City-RAND Institute

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American Academy of Arts & Sciences

Appendix C

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Dr. Robert C. Wood (CO-CHAIRMAN)
Director
M.I.T.-Harvard Joint Center for
Urban Studies

Dr. Harvey Brooks, Dean
Engineering Division and Applied
Physics
Harvard University

Dr. John S. Burlew, Director
Connecticut Research Commission

Dr. Alan Campbell, Dean
Maxwell Graduate School for
Citizenship and Public Affairs
Syracuse University

Dr. Milton U. Clauser, Director
Lincoln Laboratories
Massachusetts Institute of Technology

Mr. Avery M. Cole
Assistant Director
The New England Economic Research
Foundation

Mr. John Diebold, President
The Diebold Group, Inc.
Management and Consulting Firm

Mr. Rudolph W. Hardy
Executive Director
The New England Economic Research
Foundation

Dr. M. Frank Hersman, Staff Associate
The National Science Foundation
Office of Policy Planning

Dr. James R. Killian, Jr.
Chairman of the Corporation
Massachusetts Institute of Technology

Dr. Earl W. Lindveit, Director
Department of Housing and Urban
Development
Office of City and Regional
Administration Research

Dr. Roger Revelle
Richard Saltonstall Professor of
Population Policy
Division of the Center for Population
Studies in the School of Public Health
Harvard University

Mr. Thomas Rogers, Vice-President
Mitre Corporation

Dr. Richard S. Rosenbloom, Professor
Harvard Graduate School of Business
Administration

Dr. Harvey Sapolsky
Professor of Political Science
Massachusetts Institute of Technology

Dr. Jeurgen Schmandt, Associate Director
Harvard University Program on Technology
and Society

Dr. Donald A. Schon
Organization for Social and Technical
Innovation, Inc.

Professor Adam Yarmolinsky
Professor of Law
Member of the Kennedy Institute of Politics
Harvard Law School

Dr. Alonso Yerby, Professor and Head
Department of Health Services and
Administration
Harvard School of Public Health

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